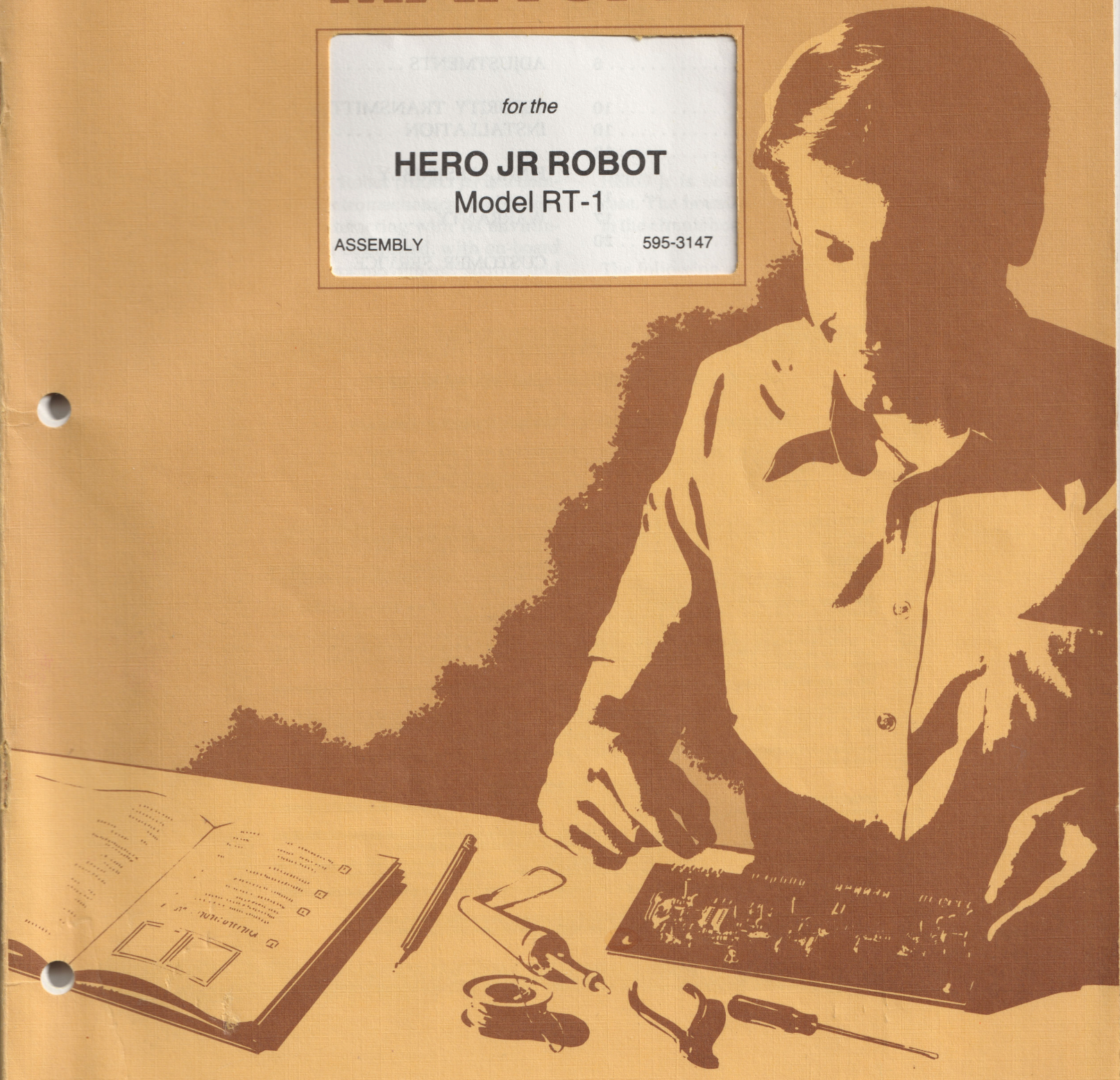
HEATHKIT®
MANUAL

for the

HERO JR ROBOT
Model RT-1

ASSEMBLY 595-3147



HEATH COMPANY • BENTON HARBOR, MICHIGAN

HEATH COMPANY PHONE DIRECTORY

The following telephone numbers are direct lines to the departments listed:

Kit orders and delivery information	(616) 982-3411
Credit	(616) 982-3561
Replacement Parts	(616) 982-3571

Technical Assistance Phone Numbers
8:00 A.M. to 12 P.M. and 1:00 P.M. to 4:30 P.M., EST, Weekdays Only

Audio	(616) 982-3310
Amateur Radio	(616) 982-3296
Test Equipment, Weather Instruments and Home Clocks	(616) 982-3315
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Aircraft, Marine, Security, Scanners, Automotive, Appliances and General Products	(616) 982-3496
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Computers — Software:	
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YOUR HEATHKIT 90-DAY LIMITED WARRANTY

Consumer Protection Plan for Heathkit Consumer Products

Welcome to the Heath family. We believe you will enjoy assembling your kit and will be pleased with its performance. Please read this Consumer Protection Plan carefully. It is a "LIMITED WARRANTY" as defined in the U.S. Consumer Product Warranty and Federal Trade Commission Improvement Act. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Heath's Responsibility

PARTS — Replacements for factory defective parts will be supplied free for 90 days from date of purchase. Replacement parts are warranted for the remaining portion of the original warranty period. You can obtain warranty parts direct from Heath Company by writing or telephoning us at (616) 982-3571. And we will pay shipping charges to get those parts to you . . . anywhere in the world.

SERVICE LABOR — For a period of 90 days from the date of purchase, any malfunction caused by defective parts or error in design will be corrected at no charge to you. You must deliver the unit at your expense to the Heath factory, any Heathkit Electronic Center (units of Veritechnology Electronics Corporation), or any of our authorized overseas distributors.

TECHNICAL CONSULTATION — You will receive free consultation on any problem you might encounter in the assembly or use of your Heathkit product. Just drop us a line or give us a call. Sorry, we cannot accept collect calls.

NOT COVERED — The correction of assembly errors, adjustments, calibration, and damage due to misuse, abuse, or negligence are not covered by the warranty. Use of corrosive solder and/or the unauthorized modification of the product or of any furnished component will void this warranty in its entirety. This warranty does not include reimbursement for inconvenience, loss of use, customer assembly, set-up time, or unauthorized service.

This warranty covers only Heath products and is not extended to other equipment or components that a customer uses in conjunction with our products.

SUCH REPAIR AND REPLACEMENT SHALL BE THE SOLE REMEDY OF THE CUSTOMER AND THERE SHALL BE NO LIABILITY ON THE PART OF HEATH FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES, INCLUDING BUT NOT LIMITED TO ANY LOSS OF BUSINESS OR PROFITS, WHETHER OR NOT FORSEEABLE.

Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you.

Owner's Responsibility

EFFECTIVE WARRANTY DATE — Warranty begins on the date of first consumer purchase. You must supply a copy of your proof of purchase when you request warranty service or parts.

ASSEMBLY — Before seeking warranty service, you should complete the assembly by carefully following the manual instructions. Heathkit service agencies cannot complete assembly and adjustments that are customer's responsibility.

ACCESSORY EQUIPMENT — Performance malfunctions involving other non-Heath accessory equipment, (antennas, audio components, computer peripherals and software, etc.) are not covered by this warranty and are the owner's responsibility.

SHIPPING UNITS — Follow the packing instructions published in the assembly manuals. Damage due to inadequate packing cannot be repaired under warranty.

If you are not satisfied with our service (warranty or otherwise) or our products, write directly to our Director of Customer Service, Heath Company, Benton Harbor MI 49022. He will make certain your problems receive immediate, personal attention.

Heathkit® Manual

for the

HERO JR ROBOT

Model RT-1

ASSEMBLY 595-3147

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

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WARNING

Federal Communications Commision requirements prescribe verification of computing devices in Part 15 Subpart J of the Rules and Regulations. This computing device will meet these requirements when constructed in strict accordance with the instructions in this manual, using only components and materials supplied with the kit or the exact equivalent thereof. You will be instructed to affix the enclosed FCC label to the equipment certifying that you have constructed this equipment in accordance with the above mentioned instructions. In order to meet legal requirements, be certain to follow the instructions exactly as they are stated in this manual.

INTRODUCTION

The Heathkit Model RT-1 Robot (HERO Jr) is a completely self-contained electromechanical mobile device that is capable of interacting with its environment. It is microprocessor controlled, with on-board electronic sensors to detect movement, sound, and light. It also measures distances and keeps time.

A three-wheeled base with both drive and steering on one wheel permits exceptional maneuverability. Under program control, HERO Jr can traverse a complex path around obstacles, activate its sensors, and modify its behavior in response to sensory inputs.

While most other robots require quite sophisticated programming skills, HERO Jr requires none. It comes with pre-programmed personality traits, which you can select from the keyboard. You can also use the keyboard to enter time and special dates.

Most of the active parts in your Robot mount on three circuit boards. Two of these circuit boards use connectors for ease of assembly. Power for your Robot is supplied by two gel-cell batteries, which are charged by a power cube.

HERO Jr is housed in an attractive molded plastic case. The housing is easy to remove, to allow access to the circuit boards or other parts of the Robot.

The following accessories are available for use with your Robot:

- RTA-1-1 Infrared Motion Detector.
- RTA-1-2 RF Remote Control.
- RTA-1-3 RS-232 I/O Interface.
- RTA-1-4 Battery Accessory.
- RTA-1-5 Cartridge Adapter.
- GDA-2800-3 RF Security Transmitter (which is part of the Heathkit Model GD-2800 Security System).

The HERO Jr Robot should provide you with many years of trouble-free service as a friend, companion, and security guard.

UNPACKING

DO NOT UNPACK ANY PART OF YOUR KIT UNTIL A STEP DIRECTS YOU TO DO SO.

Locate the "Pack Index Sheet" that is packed inside the main shipping carton for your Robot. Note that the shipping carton is divided into five smaller sections. These sections (which may be made up of several bags, envelopes, small boxes, and loose parts) make up Packs 1, 2, 3, and the Final Pack. Do NOT unpack any of these parts until a step specifically directs you to do so.

When you check parts against a "Part List," return any part or group of parts packaged in a bag or other container, with a part number on it, to its container after you identify it. Leave these parts there until you actually use them in a step. This will help to prevent you from mixing up the parts, and help you identify the parts when you need them.

You may, however, find some parts in a bag or envelope that is not marked with an actual part number. Instead, it is marked with a packaging number that begins with the number "173-." These numbers are used for packaging purposes only and do not appear in the Manual "Parts List." Open each bag or envelope that is marked with only a "173-" packaging number to identify the parts it contains.

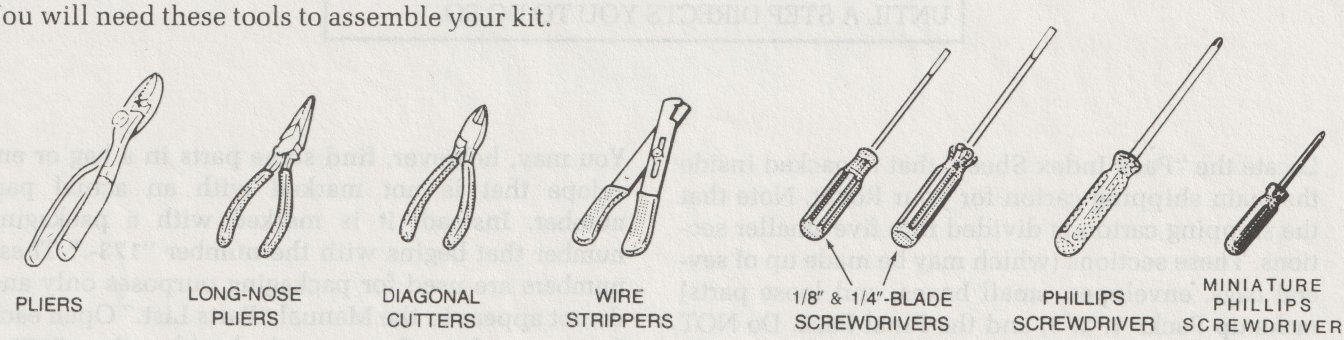
NOTE: Never use a "173-" packaging number if you must order a replacement part. Use only the part numbers listed in the Manual "Parts List" for this purpose.

Save all of the packaging material until you account for all the parts.

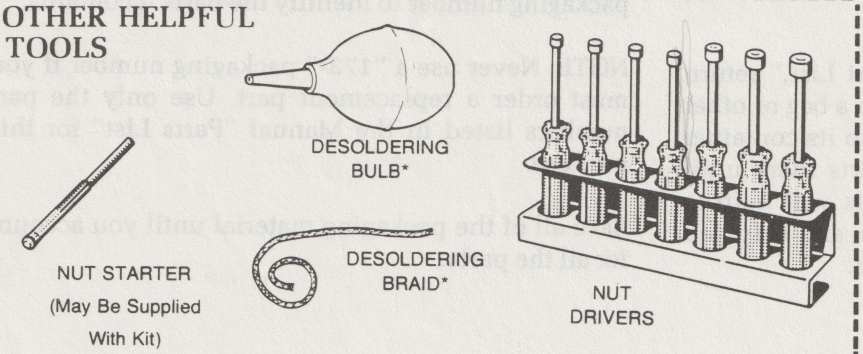
ASSEMBLY NOTES

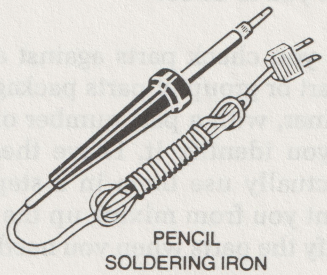
TOOLS

You will need these tools to assemble your kit.



OTHER HELPFUL TOOLS





*To Remove Solder From Circuit Connections.

ASSEMBLY

1. Follow the instructions carefully. Read the entire step before you perform each operation.

2. The illustrations in the Manual are called Pictorials and Details. Pictorials show the overall operation for a group of assembly steps; Details generally illustrate a single step. When you are directed to refer to a certain Pictorial "for the following steps," continue using that Pictorial until you are referred to another Pictorial for another group of steps.

3. Most kits use a separate "Illustration Booklet" that contains illustrations (Pictorials, Details, etc.) that are too large for the Assembly Manual. Keep the "Illustration Booklet" with the Assembly Manual. The illustrations in it are arranged in Pictorial number sequence.

4. Position all parts as shown in the Pictorials.

5. Solder a part or a group of parts only when you are instructed to do so.

6. Each circuit part in an electronic kit has its own component number (R2, C4, etc.). Use these numbers when you want to identify the same part in the various sections of the Manual. These numbers, which are especially useful if a part has to be replaced, appear:

   — In the Parts List,

   — At the beginning of each step where a component is installed,

   — In some illustrations,

   — In Troubleshooting Charts,

   — In the Schematic,

   — In the sections at the rear of the Manual.

7. When you are instructed to cut something to a particular length, use the scales (rulers) provided at the bottom of the Manual pages.

SAFETY WARNING: Avoid eye injury when you cut off excessive lead lengths. Hold the leads so they cannot fly toward your eyes.

SOLDERING

Soldering is one of the most important operations you will perform while assembling your kit. A good solder connection will form an electrical connection between two parts, such as a component lead and a circuit board foil. A bad solder connection could prevent an otherwise well-assembled kit from operating properly.

It is easy to make a good solder connection if you follow a few simple rules:

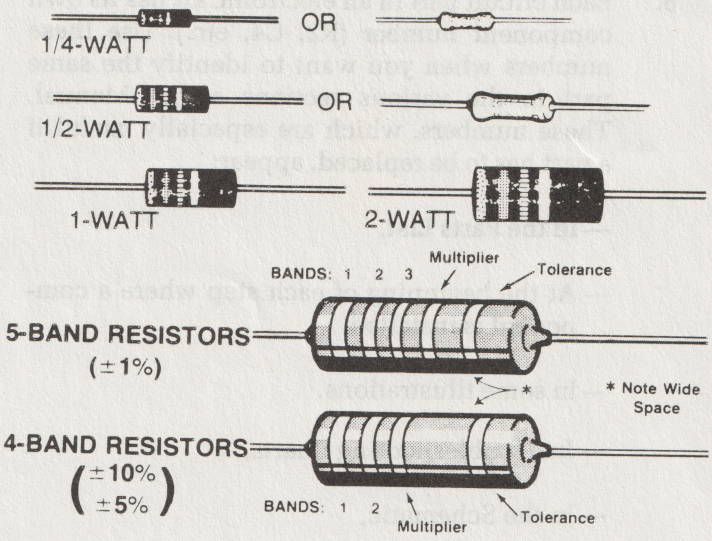
1. Use the right type of soldering iron. A 22 to 25-watt pencil soldering iron with a 1/8″ or 3/16″ chisel or pyramid tip works best.

2. Keep the soldering iron tip clean. Wipe it often on a wet sponge or cloth; then apply solder to the tip to give the entire tip a wet look. This process is called tinning, and it will protect the tip and enable you to make good connections. When solder tends to "ball" or does not stick to the tip, the tip needs to be cleaned and retinned.

NOTE: Always use rosin core, radio-type solder (60:40 tin-lead content) for all of the soldering in this kit. This is the type we have supplied with the parts. The Warranty will be void and we will not service any kit in which acid core solder or paste has been used.

PARTS

Resistors are identified in Parts Lists and steps by their resistance value in Ω (ohms), kΩ (kilohms), or MΩ (megohms). They are usually identified by a color code and four or five color bands, where each color represents a number. These colors (except for the last band, which indicates a resistor's "tolerance") will be given in the steps in their proper order. Therefore, the following color code is given for information only. NOTE: Occasionally, a "precision" or "power" resistor may have the value stamped on it.



Band 1 1st Digit	
Color	Digit
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Gray	8
White	9

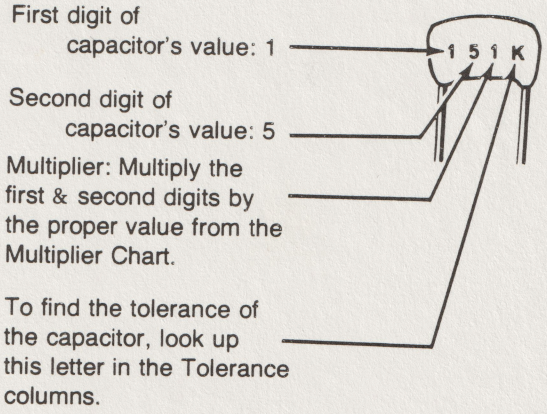
Band 2 2nd Digit	
Color	Digit
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Gray	8
White	9

Band 3 (if used) 3rd Digit	
Color	Digit
Black	0
Brown	1
Red	2
Orange	3
Yellow	4
Green	5
Blue	6
Violet	7
Gray	8
White	9

Multiplier	
Color	Multiplier
Black	1
Brown	10
Red	100
Orange	1,000
Yellow	10,000
Green	100,000
Blue	1,000,000
Silver	0.01
Gold	0.1

Resistance Tolerance	
Color	Tolerance
Silver	± 10%
Gold	± 5%
Red	± 2%
Brown	± 1%
Green	± .5%
Blue	± .25%
Violet	± .1%
Gray	± .05%

Capacitors will be called out by their capacitance value in μF (microfarads) or pF (picofarads) and type: ceramic, Mylar*, electrolytic, etc. Some capacitors may have their value printed in the following manner:


First digit of capacitor's value: 1
Second digit of capacitor's value: 5
Multiplier: Multiply the first & second digits by the proper value from the Multiplier Chart.
To find the tolerance of the capacitor, look up this letter in the Tolerance columns.
1 5 1 K

EXAMPLES:

151K = 15 × 10 = 150 pF
759 = 75 ×0.1 = 7.5 pF

NOTE: The letter "R" may be used at times to signify a decimal point: as in: 2R2 = 2.2 (pF or μF).

MULTIPLIER		TOLERANCE OF CAPACITOR		
FOR THE NUMBER:	MULTIPLY BY:	10 pF OR LESS	LETTER	OVER 10 pF
0	1	±0.1 pF	B	
1	10	±0.25 pF	C	
2	100	±0.5 pF	D	
3	1000	±1.0 pF	F	±1%
4	10,000	±2.0 pF	G	±2%
5	100,000		H	±3%
			J	±5%
8	0.01		K	±10%
9	0.1		M	±20%

*DuPont Registered Trademark.

SPECIAL ASSEMBLY NOTES

NOTE: The following suggestions will not necessarily improve the operation of your kit. They will, however, help you troubleshoot it (if it ever becomes necessary), and help you perform the "Circuit Board Checkout" steps at the end of the assembly sections of this Manual. And you will have a more professionally-built kit when you finish.

1. When you install resistors, always position each resistor so you can read the bands on the resistor in the same direction as you can read the printing on the circuit board (see Figure 1). For resistors that have the value printed on them instead of color bands, install these resistors so the values are facing away from the circuit board and read in the same direction as the printing on the circuit board.

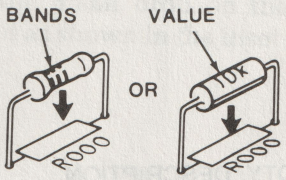


Figure 1

2. When you install ceramic, Mylar, or mica capacitors, always position each capacitor so you can read the value on the capacitor in the same direction as you can read the printing on the circuit board (see Figure 2).

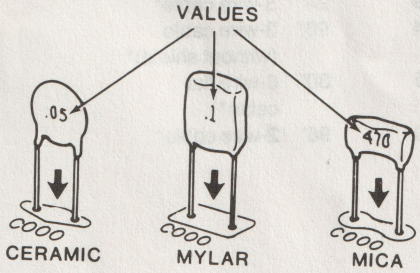


Figure 2

3. When you install electrolytic or other tubular capacitors, always position each capacitor so the value is facing away from the circuit board (see Figure 3). Be sure to observe the correct polarity when you install electrolytic capacitors (as you will be directed in the steps). Other, non-polarized, capacitors should be installed so you can read the values in the same direction as the printing on the circuit board.

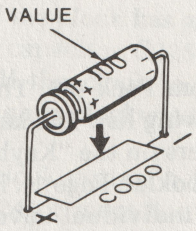


Figure 3

4. Install diodes so the type numbers or part numbers are facing away from the circuit board (see Figure 4). Be sure to match the band on one end of each diode with the band mark on the circuit board.

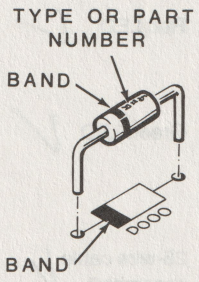


Figure 4

KEYBOARD CIRCUIT BOARD

PARTS LIST

Remove the parts from Pack #1. Then check each part against the following list. The key numbers correspond to the numbers on the "Keyboard Parts Pictorial" (Illustration Booklet, Page 1). Return any part that is packed in an individual envelope, with the part number printed on it, back to the envelope after you identify it. Keep these parts in the envelopes until they are called for in a step. Do NOT throw away any packing material until you account for all the parts.

To order a replacement part, always include the PART NUMBER. Use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of this Manual. For prices, refer to the separate "Heath Parts Price List."

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
LEDs				
A1	412-640	8	Red LED	D100, D101, D102, D103, D104, D105, D106, D107
A1	412-652	1	Green LED	D108
WIRE-CABLES				
	134-1475	1	25-wire cable assembly*	
	134-1406	1	20-wire cable assembly	
	343-15	30″	Shielded cable*	
	344-15	36″	Black wire*	
	344-16	54″	Red wire*	
	344-56	36″	Blue wire	
	344-82	24″	White wire*	
	346-35	4″ (3½″)	Small heat-shrinkable sleeving*	
	346-46	6″	Large heat-shrinkable sleeving*	
	347-19	24″	3-wire cable (with shields)*	
	347-39	24″	5-wire cable*	
	347-54	90″	3-wire cable (without shield)*	
	347-55	30″	8-wire flat cable*	
	347-60	96″	2-wire cable*	

* Set these items aside for use later.

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KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.

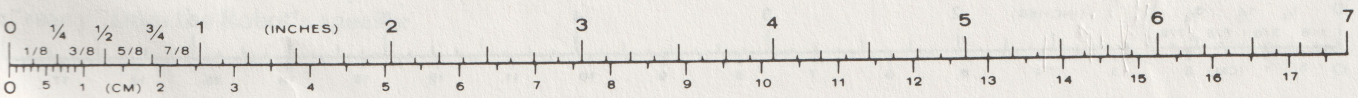
MISCELLANEOUS

IMPORTANT: Do not touch the gold-plated areas on the underside of the keypad or foil pads of the keyboard circuit board.

B1	64-939	1	Keypad
B2	74-34	2	Double-stick tape (1/2″ × 4″)
	85-3007-1	1	Keyboard circuit board
B3	205-1933	1	LED spacer
B4	390-1255	1	Fuse replacement label**
B5	390-1872	1	FCC label**
B6	390-2610	2	Decorative label**
B7	390-2611	1	Keyboard label**
B8	390-~~2676~~ 2773	1	Head label**
		1	Blue and white label**
B9	438-55	1	Polarizing plug
	597-260	1	Parts Order Form**

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
		2	Taped Component Chart (3 pages)	
		1	Owner's Guide* (see Page 1 for the part number)	
		1	Programmer's Guide* (see Page 1 for the part number)	
		1	Assembly Manual (see Page 1 for the part number)	
		1	Technical Manual (see Page 1 for the part number)	
			Solder	

** These items may be packed inside the Manual.



STEP-BY-STEP ASSEMBLY

Refer to Pictorial 1-1 (Illustration Booklet, Page 1) for the following steps.

CAUTION: When you work with the keyboard circuit board in the following steps, make sure you do not touch any of the foil pads on the underside of the circuit board with your fingers. The oil from your skin may contaminate the keypad foils and eventually cause an intermittent circuit. Also, avoid any finger contact with the underside of the keypads.

NOTES:

1. In the following steps, you will be given detailed instructions on how to prepare, install, and solder the first part on the keyboard circuit board. Read and perform each step carefully. Then use the same procedure when you install the remaining parts on the circuit board.

2. In all of the following steps, the side of the circuit board that has component (part) outlines on it will be called the "top" of the circuit board; the other side will be called the "bottom." In some cases, a circuit board may have foils on both the top and bottom sides. Be sure to note the side screened with component outlines as you install the parts.

3. Always install a wire or a component on the top side of the circuit board unless you are specifically directed otherwise in a step.

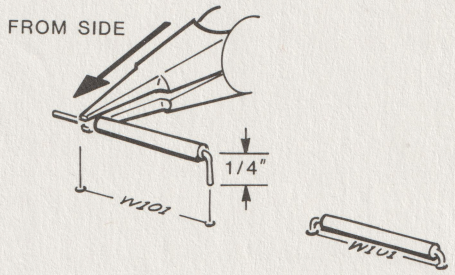
4. As you perform each step, check it off in the box provided. You may also wish to place a checkmark near each component on the Pictorial as you install it.

5. To "prepare" jumper wires, use the blue (hookup) wire supplied with this kit. Cut a wire to the indicated length; then remove 1/4" of insulation from each wire end. You may prepare wires in advance of the steps in which they will be used.

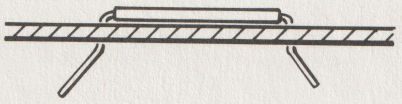
( ) Position the keyboard circuit board on your work area in front of you with the top side up as shown in Pictorial 1-1.

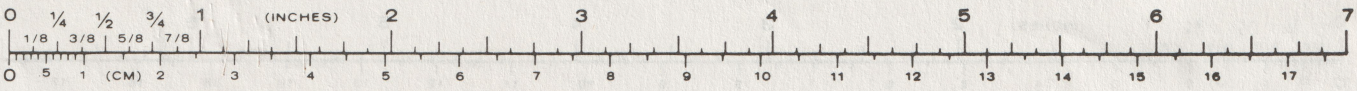
( ) Prepare a 1-1/8" jumper wire.

( ) Locate the line marked "W101" on the circuit board. Then bend the bare wire ends of the 1-1/8" wire to fit the holes at the ends of "W101" as shown. Install the wire at W101.

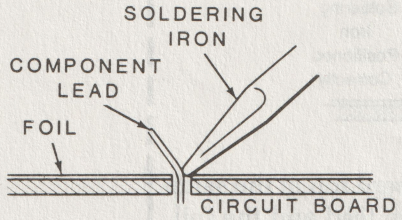


( ) On the bottom of the circuit board, bend the wire ends slightly to hold the wire in place.

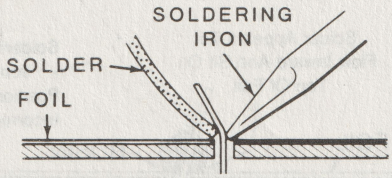




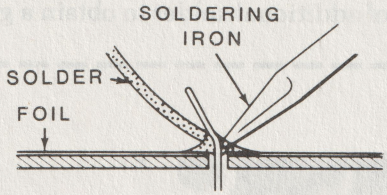
( ) Solder the wire ends to the circuit board foils as follows:



1. Push the soldering iron tip against both the lead and the circuit board foil. Heat **both** for two or three seconds.



2. Then apply solder to the other side of the connection. IMPORTANT: Let the heated lead and the circuit board foil melt the solder.



3. As the solder begins to melt, allow it to flow around the connection. Then remove the solder and the iron and let the connection cool.

( ) Cut off the excess wire ends close to the solder connection. WARNING: Clip the wires so the ends will not fly toward your eyes.

( ) Check each connection. Compare it to the illustrations on Page 14. After you have checked the solder connections, proceed with the circuit board assembly. Use the same soldering technique for each connection.

( ) Prepare the following blue (hookup) wires:

Two 1-1/8″

Two 1-1/4″

One 1-1/2″

Install the prepared wires at the following locations on the keyboard circuit board:

( ) 1-1/8″ wire at W102.

( ) 1-1/2″ wire at W103.

( ) 1-1/8″ wire at W104.

( ) 1-1/4″ wire at W105.

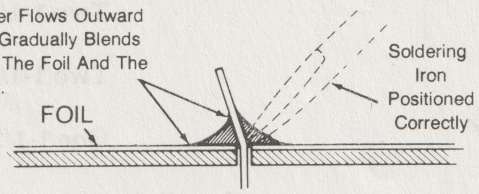
( ) 1-1/4″ wire at W106.

( ) Solder the wires to the circuit board foils and cut off the excess wire ends.

Locate the 20-wire cable assembly (#134-1406). Then route the cable wires as shown in Pictorial 1-1. Connect the bare wire ends of this cable assembly to the designated circuit board holes in the following steps. Solder each wire as you connect it and cut off the excess wire end.

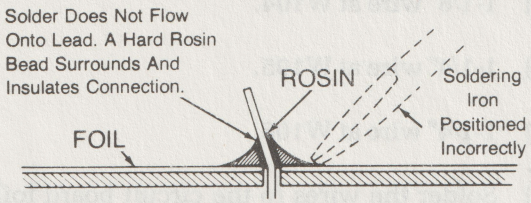
	Wire Color	Circuit Board Hole
( )	White-green	K
( )	White-blue	J
( )	White-violet	H
( )	White-gray	G
( )	Short black	F
( )	White-black	E
( )	White-brown	D
( )	White-red	C

A GOOD SOLDER CONNECTION

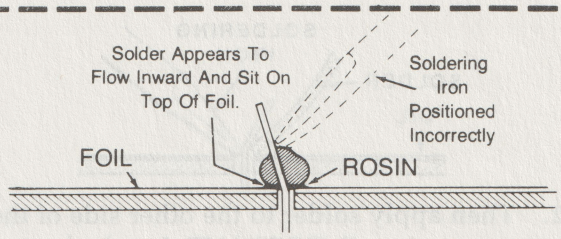


When you heat the lead and the circuit board foil at the same time, the solder will flow evenly onto the lead and the foil. The solder will make a good electrical connection between the lead and the foil.

POOR SOLDER CONNECTIONS


Solder Does Not Flow Onto Lead. A Hard Rosin Bead Surrounds And Insulates Connection.
ROSIN
FOIL
Soldering Iron Positioned Incorrectly

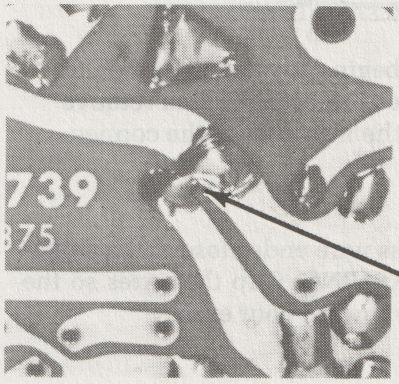
When the lead is not heated sufficiently, the solder will not flow onto the lead as shown above. To correct, reheat the connection and, if necessary, apply a small amount of additional solder to obtain a good connection.



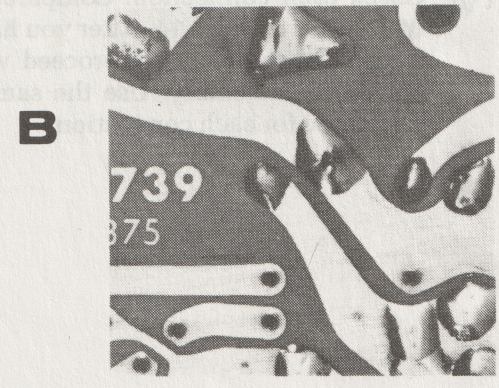
When the foil is not heated sufficiently the solder will blob on the circuit board as shown above. To correct, reheat the connection and, if necessary, apply a small amount of additional solder to obtain a good connection.

SOLDER BRIDGES

A solder bridge between two adjacent foils is shown in photograph **A**. Photograph **B** shows how the connection should appear. A solder bridge may occur if you accidentally touch an adjacent previously soldered connection, if you use too much solder, or if you "drag" the soldering iron across other foils as you remove it from the connection. A good rule to follow is: always take a good look at the foil area around each lead before you solder it. Then, when you solder the connection, make sure the solder remains in this area and does not bridge to another foil. This is especially important when the foils are small and close together. NOTE: It is alright for solder to bridge two connections on the same foil.



Use only enough solder to make a good connection, and lift the soldering iron straight up from the circuit board. If a solder bridge should develop, turn the circuit board foil-side-down and heat the solder between connections. The excess solder will run onto the tip of the soldering iron, and this will remove the solder bridge. NOTE: The foil side of most circuit boards has a coating on it called "solder resist." This is a protective insulation to help prevent solder bridges.



( )	White-orange	B
( )	White-yellow	A
( )	Red	Z
( )	Orange	Y
( )	Yellow	X
( )	Green	U
( )	Blue	T
( )	Violet	S
( )	Gray	R
( )	White	P
( )	Long black	N
( )	Brown	L

( ) Position the 25-pin socket (S203) with the connector slots up as shown. Count nine slots from the lower end; then push a polarizing plug into the ninth hole. Make sure the plug is inserted into the hole as far as it will go.

Refer to Pictorial 1-2 (Illustration Booklet, Page 1) for the following steps.

NOTE: In the following steps, when you install LEDs (light-emitting diodes) on the circuit board, you will **mount them on the bottom side** of the board.

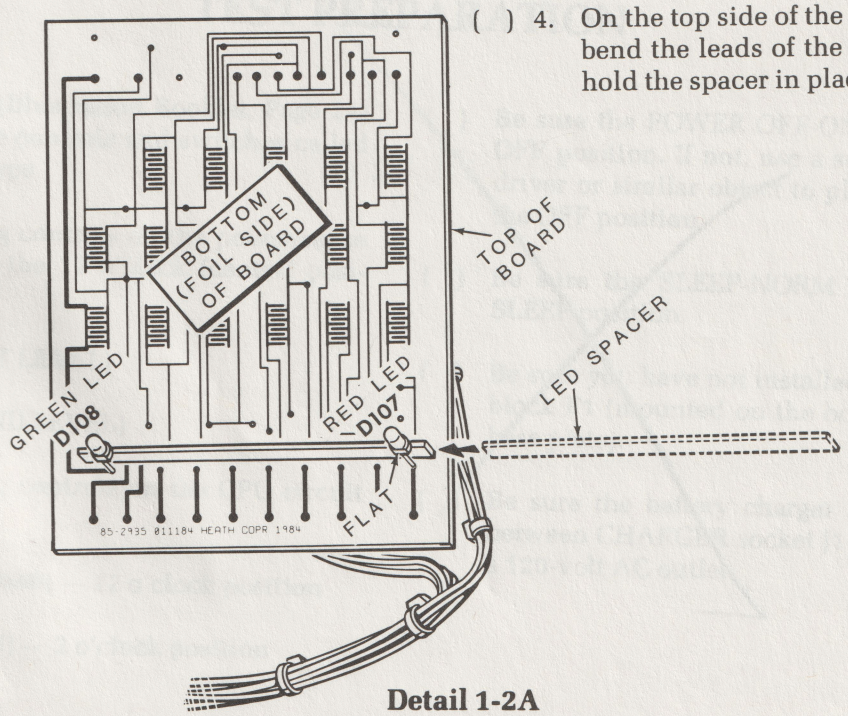
Refer to Detail 1-2A for the next four steps.

( ) 1. Place a red LED into the holes at D107, making sure the flat on the LED is positioned toward the near edge of the circuit board as shown, and as indicated by the dotted outline at D107 on the top of the circuit board. Bend the leads of the LED out slightly to hold it in place temporarily. IMPORTANT: If an LED is installed incorrectly, it will not work. Do not solder the LED leads yet.

( ) 2. In the same manner, install a green LED at D108. Do not solder the LED leads yet.

( ) 3. Slide the LED spacer in between the leads of D107 at one end of the circuit board, all the way across the circuit board, and between the leads of D108 in the manner shown. Raise each LED just enough to allow the LED body to rest on the edge of the spacer.

( ) 4. On the top side of the circuit board, sharply bend the leads of the two LEDs to securely hold the spacer in place.



Detail 1-2A

NOTE: In the following steps, install each of the remaining red LEDs so its leads straddle the LED spacer, and the LED flat is toward the near edge of the circuit board. Bend the leads sharply on the top of the circuit board. Do not solder the leads until you are instructed to do so.

( ) Red LED at D100.

( ) Red LED at D101.

( ) Red LED at D102.

( ) Red LED at D103.

( ) Red LED at D104.

( ) Red LED at D105.

( ) Red LED at D106.

( ) Sight along the tops of the eight LEDs, making sure all the tops are in a straight line and that the flat of each LED is positioned correctly. Then, on each side of the LED spacer on the bottom of the circuit board, solder the leads to the circuit board foils.

( ) On the top of the circuit board, cut off the excess lead lengths.

( ) Carefully slide the LED spacer from between all of the LED leads. NOTE: Save the spacer for use later.

CAUTION: Do not handle the underside of the keypad, or touch the circuit board keypad foils in the following steps.

( ) Tear off the **unlettered** strip of keys from the keypad along the scored line. Discard the unlettered keys.

( ) Position the lettered keypad onto the bottom of the circuit board, making sure the letters on the keys match the lettering on the top of the circuit board. The small rubber studs in the keypad should align with the circuit board holes as shown.

( ) If necessary, use small strips of thin tape (cellophane or electrical, for example), to secure the keypad in place on the bottom of the keyboard circuit board.

This completes the "Step-by-Step Assembly" of the keyboard circuit board. Set it aside until it is called for in a step. Proceed to "Power/Sense Circuit Board."

POWER/SENSE CIRCUIT BOARD

PARTS LIST

Remove the parts from Pack #2. Then check each part against the following list. Do not remove components that are supplied on a tape from the tape until you use them in a step. Return any part that is packed in an individual envelope, with the part number printed on it, back to the envelope after you identify it. Keep these parts in the envelopes until they are called for in a step. Do NOT throw away any packing material until you account for all the parts.

The key numbers correspond to the numbers on the "Power/Sense Circuit Board Parts Pictorial" (Illustration Booklet, Page 2).

To order a replacement part, always include the PART NUMBER. Use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of this Manual. For prices, refer to the separate "Heath Parts Price List."

TAPED COMPONENTS

NOTE: These parts are taped on a strip which was checked before shipment. Since these parts are taped in the order of assembly, you may not wish to check them against the following list.

RESISTORS

NOTE: The following resistors are rated at 1/4-watt, have a tolerance of 1%, and a temperature coefficient (TC) of 100 parts per million per °C (100 PPM/ °C). All color-coded resistors have five color bands. A 1% tolerance is indicated by a brown fifth color band.

HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
6-1870-12	1	187 Ω (brn-gry-viol-blk)	R303
6-1501-12	1	1500 Ω (brn-grn-blk-brn)	R302
6-4751-12	3	4750 Ω (yel-viol-grn-brn)	R305, R306 R307
6-4991-12	21	4990 Ω (yel-wht-wht-brn)	R361, R359
6-5491-12	1	5490 Ω (grn-yel-wht-brn)	R304
6-9091-12	1	9090 Ω (wht-blk-wht-brn)	R359
6-3012-12	1	30.1 kΩ (org-blk-brn-red)	R308
6-7503-12	1	750 kΩ (viol-grn-blk-org)	R317
6-8873-12	1	887 kΩ (gry-gry-viol-org)	R316

HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.

NOTE: The following resistors are rated at 1/4-watt and have a tolerance of 5%, which is indicated by a gold fourth color band.

6-470-12	3	47 Ω (yel-viol-blk)	R338, R339, R352
6-271-12	1	270 Ω (red-viol-brn)	R319
6-471-12	1	470 Ω (yel-viol-brn)	R331
6-511-12	1	510 Ω (grn-brn-brn)	R311
6-681-12	2	680 Ω (blu-gry-brn)	R301, R363
6-821-12	1	820 Ω (gry-red-brn)	R315
6-102-12	11	1000 Ω (brn-blk-red)	R312, R342, R344, R345, R353, R368, R369, R371, R372, R373, R374
6-152-12	2	1500 Ω (brn-grn-red)	R313, R354
6-472-12	16	4700 Ω (yel-viol-red)	R309, R323, R326, R327, R328, R329, R332, R333, R334, R335, R343, R346, R347, R355, R362, R365
6-103-12	8	10 kΩ (brn-blk-org)	R318, R341, R351, R356, R357, R364, R366, R367
6-123-12	1	12 kΩ (brn-red-org)	R314
6-683-12	1	68 kΩ (blu-gry-org)	R358
6-104-12	3	100 kΩ (brn-blk-yel)	R321, R322, R348
6-564-12	1	560 kΩ (grn-blu-yel)	R324
6-225-12	1	2.2 MΩ (red-red-grn)	R336

HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.

CAPACITORS

21-763	2	330 pF (331) glass ceramic	C321, C326
21-784	2	.001 µF (102) glass ceramic	C322, C335
21-761	8	.01 µF (103) glass ceramic	C304, C306, C307, C308, C317, C336, C337, C339
21-762	15	.1 µF (104) glass ceramic	C302, C303, C309, C314, C316, C318, C328, C331, C332, C342, C343, C344, C345, C346, C347

DIODES

56-56	2	1N4149	D302, D303
56-85	1	SZ5.0	D304
56-612	1	1N5229B	D308
56-617	2	1N5277B	D306, D307
57-65	4	1N4002	D305, D309, D311, D312
57-607	2	1N5817	D301, D313

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NON-TAPED PARTS

The following parts are not taped on strips. The key numbers correspond to the numbers on the "Power/Sense Circuit Board Parts Pictorial" (Illustration Booklet, Page 2).

CAPACITORS

Electrolytic

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
A1	25-922	1	.68 µF	C301
A1	25-900	1	1 µF	C334
A1	25-917	3	10 µF	C305, C315, C341
A1	25-948	5	100 µF	C312, C323, C325, C327, C329
A1	25-905	1	470 µF	C313
A2	25-935	2	1000 µF	C311, C338

Other Capacitors

A3	27-103	1	.0022 µF Mylar	C333
A4	27-64	2	.033 µF Mylar	C319, C324

TRANSISTORS-INTEGRATED CIRCUITS (ICs)

NOTE: Transistors and integrated circuits may be marked for identification in one of the following four ways:

1. Part number.
2. Type number. (For integrated circuits, this refers only to the numbers and letters shown in **bold** print in the Parts List. Disregard any other numbers or letters on the IC.)
3. Part number and type number.
4. Part number with a type number other than the one listed.

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
B1	417-881	1	MPSA13 transistor	Q322
B1	417-801	5	MPSA20 transistor	Q303, Q305, Q306, Q311, Q315
B1	417-865	1	MPSA55 transistor	Q314
B1	417-295	1	MPSL51 transistor	Q302
B2	417-224	1	MPSU05 transistor	Q313
B1	417-233	2	2N3643 transistor	Q308, Q312
B1	417-235	3	2N4121 transistor	Q304, Q307, Q309
B3	417-289	1	2N6109 transistor	Q301
B3	417-918	5	2N6387 transistor	Q316, Q317, Q318, Q319, Q321
B4	442-765	1	TL852CN IC	U308
B4	442-75	1	311 IC	U303
B4	442-700	1	3524 IC	U302
B5	442-674	1	7812 IC	U301
B4	443-1189	1	ADC0831	U306
B4	443-1188	1	TL851CN	U307
B4	443-785	1	74C221 IC	U305
B4	443-778	1	14093 IC	U304

CONNECTORS

C1	432-767	2	3-pin angle plug	P308, P310
C2	432-946	1	25-pin plug	P301
C3	432-1130	3	6-pin plug	P307, P309, P311
C4	432-1149	1	8-pin plug	P302/P303
C5	432-1265	3	3-pin straight plug	P304, P305, P306
C6	434-230	2	8-pin IC socket	
C6	434-298	1	14-pin IC socket	
C6	434-299	4	16-pin IC socket	

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
OTHER ELECTRONIC PARTS				
D1	6-106-12	1	10 MΩ (brn-blk-blu) 1/4-watt, 5% resistor	R370
D2	10-928	1	1 MΩ control	R337
D2	10-1049	1	2 MΩ control	R349
D3	40-2119	1	1 mH choke	L302
D4	46-71	1	650 μH choke	L301
D5	52-194	1	Sonar transformer	T301
D6	69-106	1	Relay	RY301
D7	352-13	1	Silicone grease	
D8	404-682	1	420 kHz crystal	Y301

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
MISCELLANEOUS				
E1	215-89	2	Heat sink	
E2	250-1411	2	4-40 × 1/4" screw	
E3	252-2	2	4-40 nut	
E4	254-9	2	#4 lockwasher	
PART FROM THE FINAL PACK				
	85-2993-3	1	Power/sense circuit board	

STEP-BY STEP ASSEMBLY

Refer to Pictorial 2-1 (Illustration Booklet, Page 3) as you read the following notes and perform the following steps.

NOTES:

1. Some circuit board drawings, such as the one shown in Pictorial 2-1, are divided into two or more sections. These sections show you which area of the circuit board you are working in for a specific series of steps.

2. Refer to the "Taped Component Chart," Page 1. Note that it is divided into numbered sections which correspond to the numbered sections on the circuit board Pictorial.

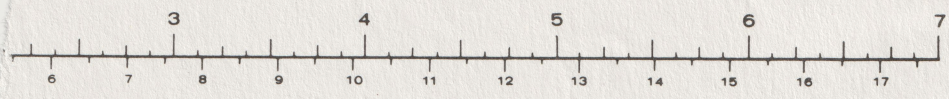
3. In each series of steps, which correspond to a circuit board section, you will install parts in a top-to-bottom, left-to-right sequence. Occasionally, you may be directed to install a particular component in an area out of sequence. Each of these components is identified in the step and on the Pictorial with a special callout (R201, C403, or D111, for example).

4. As previously noted, solder instructions are given only at the end of a series of similar steps; you may solder more often if you wish.

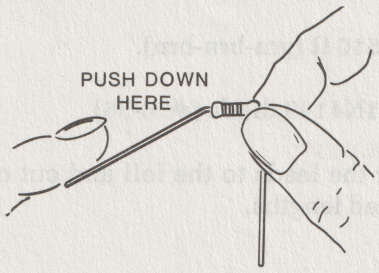
IMPORTANT: Although you have been given detailed instructions on how to install and solder wires on the circuit board, the following instructions will instruct you in the use of the "Taped Component Chart." Read and perform each step carefully. Then use the same procedure as you install the remaining parts on the circuit board.

Note that the circuit board has foil patterns on one side, and the other side has outlines of components (parts) shown on it. The foil side of the circuit board will be referred to as the "bottom" of the circuit board; the side with the outlines will be called the "top" of the circuit board.

( ) Position the circuit board on your work area in front of you with the top side up as shown in Pictorial 2-1. NOTE: Always install parts on the top of the circuit board and solder the leads or wires to the bottom circuit board foil pads, unless a step instruction specifically directs you to do otherwise.

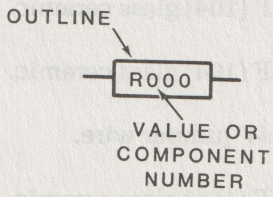


( ) Cut the first part, a 187 Ω, 1% (brn-gry-viol-blk) resistor from the Taped Component Chart as outlined in the Chart instructions. Bend the resistor leads as shown to fit the hole spacing for R303 on the circuit board.

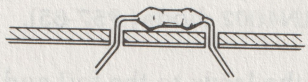


( ) R303: Start the leads into the holes at the resistor's location near the top of Section 1 of the circuit board. You may position the end with the color bands either way.

NOTE: Resistors are identified by the following outline:



( ) Press the resistor down against the top of the circuit board. Then bend the leads outward slightly to hold it in place.



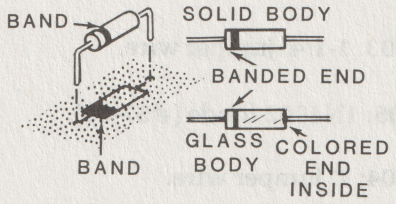
( ) Solder the resistor leads to the circuit board as you did when you installed the wires in the previous step.

( ) Cut off the excess lead lengths close to the connection. Again, be sure to clip the leads so the ends will not fly toward your eyes.

( ) Check each connection. If necessary, refer again to the illustrations on Page 14 and compare these connections to those shown. After you have checked the solder connections, proceed with the assembly on this and on the following pages. Use the same soldering technique for each connection.

Start at the top of Section 1 and install the following parts. The sequence of the steps matches the location of the parts on the circuit board. NOTE: Make sure you installed R303 in an earlier step.

NOTE: In the following steps, when you install diodes, always be sure to position the banded end of the diode in the circuit board to match the banded end printed on the board. **If a diode is installed incorrectly, the circuit will not operate properly. This may cause damage to other components in the circuit.**



CAUTION: ALWAYS POSITION THE BANDED END OF A DIODE AS SHOWN ON THE CIRCUIT BOARD.

Section 1

( ) C302: .1 µF (104) glass ceramic capacitor.

( ) R302: 1500 Ω, 1% (brn-grn-blk-brn) resistor.

NOTE: In the following steps, resistors will be called out only by an "R---" number, capacitors by a "C---" number, and diodes by a "D---" number.

( ) R301: 680 Ω (blu-gry-brn).

( ) D313: 1N5817 diode (#57-607).

( ) C303: .1 µF (104) glass ceramic.

( ) R309: 4700 Ω (yel-viol-red).

( ) C308: .01 µF (103) glass ceramic.

( ) R317: 750 kΩ, 1% (viol-grn-blk-org).

( ) C316: .1 µF (104) glass ceramic.

( ) Solder the leads to the foil and cut off the excess lead lengths.

Section 2

( ) Prepare a 1-1/4", a 1" and a 3/4" blue jumper wire. Set them aside until they are called for later in this section.

( ) C306: .01 µF (103) glass ceramic.

( ) R307: 4750 Ω, 1% (yel-viol-grn-brn).

( ) R305: 4750 Ω, 1% (yel-viol-grn-brn).

( ) R306: 4750 Ω, 1% (yel-viol-grn-brn).

( ) C307: .01 µF (103) glass ceramic.

( ) W303: 1-1/4" jumper wire.

( ) D305: 1N4002 diode (#57-65).

( ) W304: 1" jumper wire.

( ) R316: 887 kΩ, 1% (gry-gry-viol-org).

( ) D304: SZ5.0 diode (#56-85).

( ) R315: 820 Ω (gry-red-brn).

( ) R318: 10 kΩ (brn-blk-org).

( ) W307: 3/4" jumper wire.

(✓) Solder the leads to the foil and cut off the excess lead lengths.

Section 3

( ) C342: .1 µF (104) glass ceramic.

( ) D312: 1N4002 diode (#57-65).

( ) R304: 5490 Ω, 1% (grn-yel-wht-brn).

( ) C314: .1 µF (104) glass ceramic.

( ) D301: 1N5817 diode (#57-607).

( ) R312: 1000 Ω (brn-blk-red).

( ) R308: 30.1 kΩ, 1% (org-blk-brn-red).

( ) R314: 12 kΩ (brn-red-org).

( ) R313: 1500 Ω (brn-grn-red).

( ) D302: 1N4149 diode (#56-56).

( ) R311: 510 Ω (grn-brn-brn).

( ) D303: 1N4149 diode (#56-56).

( ) Solder the leads to the foil and cut off the excess lead lengths.

Section 4

( ) Prepare a 1" and a 1-1/4" jumper wire. Use these wires when they are called for in this section.

( ) W300: 1" jumper wire.

( ) C343: .1 µF (104) glass ceramic.

( ) C344: .1 µF (104) glass ceramic.

( ) W301: 1-1/4" jumper wire.

( ) C346: .1 µF (104) glass ceramic.

( ) D309: 1N4002 diode (#57-65).

( ) C347: .1 µF (104) glass ceramic.

( ) D311: 1N4002 diode (#57-65).

(✓) Solder the leads to the foil and cut off the excess lead lengths.

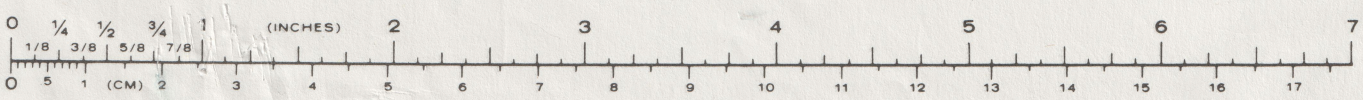
Section 5

( ) Prepare a 1-1/8" blue jumper wire. Set it aside temporarily.

( ) C345: .1 µF (104) glass ceramic.

( ) C304: .01 µF (103) glass ceramic.

( ) R372: 1000 Ω (brn-blk-red).



( ) R373: 1000 Ω (brn-blk-red).

( ) R371: 1000 Ω (brn-blk-red).

( ) R369: 1000 Ω (brn-blk-red).

( ) R368: 1000 Ω (brn-blk-red).

( ) R374: 1000 Ω (brn-blk-red).

( ) C309: .1 µF (104) glass ceramic.

( ) W305: 1-1/8″ jumper wire.

( ) Solder the leads to the foil and cut off the excess lead lengths.

Section 6

( ) Prepare a 1″ blue jumper wire. Set it aside temporarily.

( ) R361: 4990 Ω, 1% (yel-wht-wht-brn).

( ) R359: 9090 Ω, 1% (wht-blk-wht-brn).
4990 Ω, 1% (yel-wht-wht-brn).

( ) W315: 1″ jumper wire.

( ) C337: .01 µF (103) glass ceramic.

( ) C336: .01 µF (103) glass ceramic.

( ) C335: .001 µF (102) glass ceramic.

( ) R358: 68 kΩ (blu-gry-org).

( ) R331: 470 Ω (yel-viol-brn).

( ) D306: 1N5277B diode (#56-617).

( ) D307: 1N5277B diode (#56-617).

( ) Solder the leads to the foil and cut off the excess lead lengths.

Section 7

( ) Prepare two 3/4″ blue jumper wires. Use these wires when they are called for in this section.

( ) W329: 3/4″ jumper wire.

( ) W328: **Do not install a wire at this location.**

( ) W327: **Do not install a wire at this location.**

( ) W326: 3/4″ jumper wire.

( ) R326: 4700 Ω (yel-viol-red).

( ) R327: 4700 Ω (yel-viol-red).

( ) R328: 4700 Ω (yel-viol-red).

( ) R325: **Do not install a resistor at this location.**

( ) R323: 4700 Ω (yel-viol-red).

( ) C322: .001 µF (102) glass ceramic.

( ) Solder the leads to the foil and cut off the excess lead lengths.

Section 8

( ) Prepare two 1″ and one 1-1/4″ jumper wire. Set these wires aside temporarily.

( ) R354: 1500 Ω (brn-grn-red).

( ) W311: 1″ jumper wire.

( ) R345: 1000 Ω (brn-blk-red).

( ) W312: 1″ jumper wire.

( ) C332: .1 µF (104) glass ceramic.

( ) C331: .1 µF (104) glass ceramic.

( ) R352: 47 Ω (yel-viol-blk).

( ) R351: 10 kΩ (brn-blk-org).

( ) R348: 100 kΩ (brn-blk-yel).

( ) C328: .1 μF (104) glass ceramic.

( ) W320: 1-1/4″ jumper wire.

( ) R347: 4700 Ω (yel-viol-red).

( ) R344: 1000 Ω (brn-blk-red).

( ) R346: 4700 Ω (yel-viol-red).

( ) R338: 47 Ω (yel-viol-blk).

( ) R334: 4700 Ω (yel-viol-red).

( ) C321: 330 pF (331) glass ceramic.

( ) R324: 560 kΩ (grn-blu-yel).

( ) Solder the leads to the foil and cut off the excess lead lengths.

Section 9

( ) Prepare and set aside the following blue jumper wires:

Two 1-1/8″

One 1-1/4″

One 1″

( ) R355: 4700 Ω (yel-viol-red).

( ) W313: 1-1/8″ jumper wire.

( ) W314: 1-1/4″ jumper wire.

( ) W318: 1-1/8″ jumper wire.

( ) R353: 1000 Ω (brn-blk-red).

( ) R342: 1000 Ω (brn-blk-red).

( ) W322: 1″ jumper wire.

( ) R341: 10 kΩ (brn-blk-org).

( ) R339: 47 Ω (yel-viol-blk).

( ) R335: 4700 Ω (yel-viol-red).

( ) R336: 2.2 MΩ (red-red-grn).

( ) C326: 330 pF (331) glass ceramic.

( ) R343: 4700 Ω (yel-viol-red).

( ) R333: 4700 Ω (yel-viol-red).

( ) R329: 4700 Ω (yel-viol-red).

( ) R332: 4700 Ω (yel-viol-red).

( ) Solder the leads to the foil and cut off the excess lead lengths.

Section 10

( ) Prepare and set aside the following blue jumper wires:

One 1-1/8″

Three 7/8″

( ) W309: 1-1/8″ jumper wire.

( ) W310: 7/8″ jumper wire.

( ) R367: 10 kΩ (brn-blk-org).

( ) R362: 4700 Ω (yel-viol-red).

( ) W316: 7/8″ jumper wire.

( ) R363: 680 Ω (blu-gry-brn).

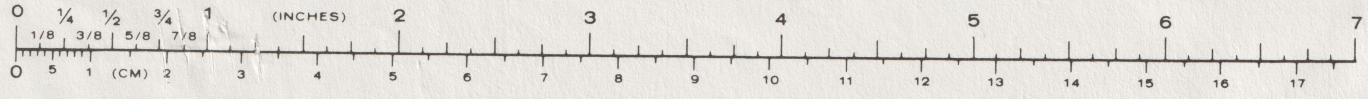
( ) R364: 10 kΩ (brn-blk-org).

( ) R357: 10 kΩ (brn-blk-org).

( ) R356: 10 kΩ (brn-blk-org).

( ) C339: .01 μF (103) glass ceramic.

( ) R321: 100 kΩ (brn-blk-yel).



( ) W323: 7/8″ jumper wire.

( ) C318: .1 μF (104) glass ceramic.

( ) R322: 100 kΩ (brn-blk-yel).

( ) Solder the leads to the foil and cut off the excess lead lengths.

Section 11

( ) Prepare and set aside the following blue jumper wires:

Two 3/4″

One 7/8″

One 1″

( ) W317: 3/4″ jumper wire.

( ) W321: 1″ jumper wire.

( ) R365: 4700 Ω (yel-viol-red).

( ) R366: 10 kΩ (brn-blk-org).

( ) W324: 7/8″ jumper wire.

( ) C317: .01 μF (103) glass ceramic.

( ) W325: 3/4″ jumper wire.

( ) R319: 270 Ω (red-viol-brn).

( ) D308: 1N5229B diode (#56-612).

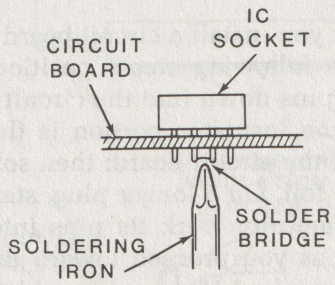
( ) Solder the leads to the foil and cut off the excess lead lengths.

NOTE: This completes the installation of parts from the first of the Taped Component Charts. There should be no taped components remaining on this Chart.

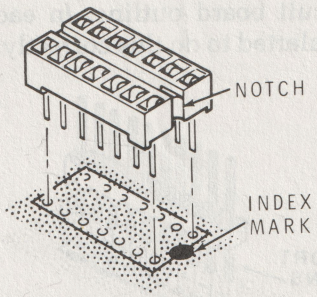
Refer to Pictorial 2-2 (Illustration Booklet, Page 4) for the following steps.

NOTE: In the following steps, you will work on the whole circuit board by starting at the top left and proceed toward the bottom right. You will first install the IC sockets, continue with the circuit board plugs and transistors, and finish with a crystal.

CAUTION: As you install IC sockets, be very careful that you do not bridge solder between socket pins. (Solder that is bridged between two pins that are on the same foil is all right). If you should create a solder bridge, hold the circuit board bottom side down as shown. Then hold your soldering iron tip between the two points where solder is bridged. The solder will flow down the iron. You can also use desoldering braid (not supplied) to remove a solder bridge.



To install IC sockets, as in the following steps, be sure the socket pins are straight; then insert the socket pins into their designated holes. The notch on the socket should be positioned to correspond with the index mark on the circuit board as shown. The index mark must still be visible after you have installed the socket. Solder the pins to the foil as you install each socket. The sockets supplied in your kit may have more or fewer pins than shown here.



NOTE: As you install each part called for in this Pictorial, solder its leads to the foil and, if applicable, cut off any excess lead lengths.

( ) 16-pin IC socket at U302.

( ) 8-pin IC socket at U303.

( ) 16-pin IC socket at U308.

( ) 16-pin IC socket at U307.

( ) 8-pin IC socket at U306.

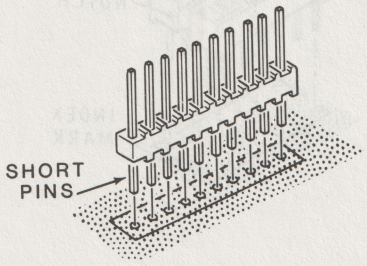
( ) 14-pin IC socket at U304.

( ) 16-pin IC socket at U305.

NOTES:

1. When you install a circuit board plug in each of the following steps, position it with its short pins down into the circuit board. Make sure the insulator portion is flush with the top of the circuit board; then solder the pins to the foil. On a longer plug, start at one end and carefully work its pins into the circuit board as you proceed toward the other end. You may find a screwdriver blade handy for this. Just start the pins into the circuit board; then go back and push the insulator down flush. Some connectors will have more and others fewer pins than those shown here.

2. In some steps, you will be instructed to pull a pin from a plug. When you do this, refer to the plug numbers on the circuit board; then position the plug so the space where you removed the pin is over the correct location on the circuit board outline. In each case, you will be alerted to do this correctly.

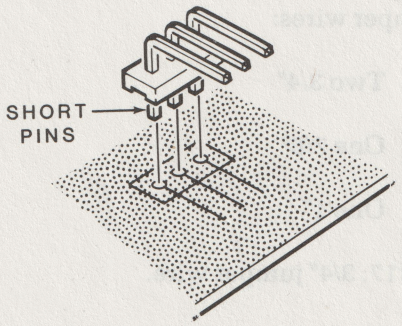


3. Discard any pins that you are instructed to pull from a plug.

( ) P307: 6-pin plug. Use long-nose pliers to pull the third pin (from either end) from the plug. Install the plug at P307 on the circuit board. NOTE: Be sure the space in the plug is at the pin 3 location on the circuit board.

( ) P306: 3-pin plug.

( ) P308: 3-pin angle plug. Install this plug with the pins pointing toward the near edge of the circuit board as shown.



( ) P309: 6-pin plug. Pull pin 3 from this plug; then be sure to install the plug with the space at the pin 3 location.

( ) P310: 3-pin angle plug.

( ) P301: 25-pin plug. Pull pin 12 from this plug; then be sure to install this plug with the space at the pin 12 location.

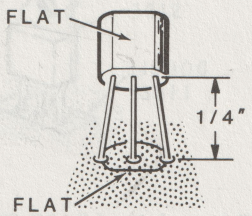
( ) P305: 3-pin plug.

( ) P304: 3-pin plug.

( ) P311: 6-pin plug. Pull pin 2 from this plug; then be sure to install the plug with the space at the pin 2 location.

( ) P302/P303: One 8-pin plug. Pull pins 2 and 7 from this plug. (Note that the pulled pins are at the same location from either end of the plug.) Install the plug at P302/P303 in either direction.

NOTE: When you install a transistor in each of the following steps, be sure to position the flat on the transistor over the outline of the flat on the circuit board as shown. Then insert the leads into the circuit board holes and solder them to the foil. Cut off any excess lead lengths.



NOTE: Transistors may be marked for identification in any one of the following four ways:

1. Part number.
2. Type number.
3. Part number and type number.
4. Part number with a type number other than the one listed.

( ) Q302: MPSL51 transistor (#417-295).

( ) Q322: MPSA13 transistor (#417-881).

( ) Q312: 2N3643 transistor (#417-233).

( ) Q314: MPSA55 transistor (#417-865).

( ) Q308: 2N3643 transistor (#417-233).

( ) Q311: MPSA20 transistor (#417-801).

( ) Q307: 2N4121 transistor (#417-235).

( ) Q309: 2N4121 transistor (#417-235).

( ) Q306: MPSA20 transistor (#417-801).

( ) Q315: MPSA20 transistor (#417-801).

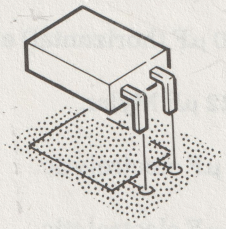
( ) Q305: MPSA20 transistor (#417-801).

( ) Q303: MPSA20 transistor (#417-801).

( ) Q304: 2N4121 transistor (#417-235).

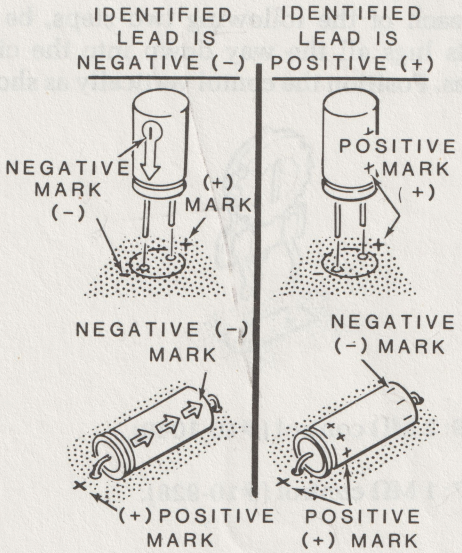
NOTE: If the crystal leads are too short in the following step, mount the crystal vertically.

( ) Y301: ~~Bend~~ Mount the leads of the 420 kHz crystal (#404-682) ~~90 degrees as shown. Then mount the crystal~~ at Y301 on the circuit board and solder the leads to the foil. Cut off the excess lead ends.



Refer to Pictorial 2-3 (Illustration Booklet, Page 4) for the following steps.

NOTE: When you install an electrolytic capacitor in each of the following steps, always match the negative (−) mark on the capacitor with the negative (−) mark on the circuit board, OR match the positive (+) mark on the capacitor with the positive (+) mark on the circuit board.



( ) C301: .68 µF electrolytic.

( ) C313: 470 µF electrolytic.

( ) C305: 10 µF electrolytic.

( ) C312: 100 µF electrolytic.

( ) C315: 10 µF electrolytic.

( ) C338: 1000 µF (horizontal) electrolytic.

( ) C329: 100 µF electrolytic.

( ) C334: 1 µF electrolytic.

( ) C311: 1000 µF (horizontal) electrolytic.

( ) C333: .0022 µF Mylar.

( ) C327: 100 µF electrolytic.

( ) C325: 100 µF electrolytic.

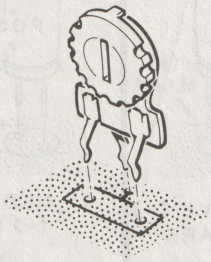
( ) C323: 100 µF electrolytic.

( ) C319: .033 µF Mylar.

( ) C324: .033 µF Mylar.

( ) C341: 10 µF electrolytic.

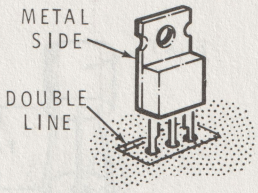
NOTE: When you install a control on the circuit board in each of the following two steps, be sure to push its lugs all the way down into the circuit board holes. Position the contol vertically as shown.



( ) R349: 2 MΩ control (#10-1049).

( ) R337: 1 MΩ control (#10-928).

NOTE: When you install transistors in each of the following five steps, be sure to position the exposed metal back on the transistor over the double lines on the circuit board. As you install each transistor, solder its leads to the foil and cut off the excess lead lengths.



Mount a 2N6387 transistor (#417-918) at each of the following five locations on the circuit board:

( ) Q316.

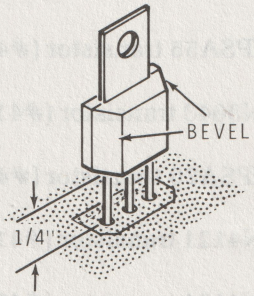
( ) Q317.

( ) Q318.

( ) Q319.

( ) Q321.

( ) Q313: MPSU05 transistor (#417-224). When you install this transistor, be sure to match its front corner beveled edges with the beveled corners printed on the circuit board as shown.



Refer to Pictorial 2-4 (Illustration Booklet, Page 5) for the following steps.

IMPORTANT: Before you install the integrated circuits (ICs) in the following steps, be sure you carefully read the information in Figure 4 (Illustration Booklet, Page 5).

( ) U302: 3524 IC (#442-700).

( ) U303: 311 IC (#442-75).

( ) U308: TL852CN IC (#442-765).

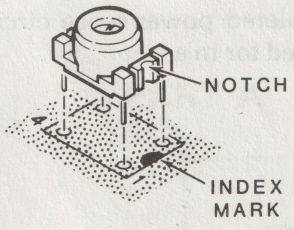
( ) U307: TL851CN IC (#443-1188).

( ) U306: ADC0831 IC (#443-1189).

( ) U304: 14093 IC (#443-778).

( ) U305: 74C221 IC (#443-785).

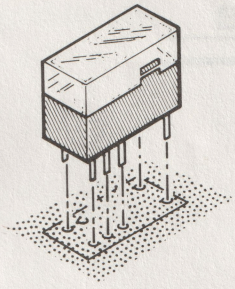
NOTE: In each of the next two steps, be sure to match the small notch in the component (choke and transformer) with the index mark on the circuit board as shown. As you mount each component, solder its leads to the foil.



( ) L302: 1 mH choke (#40-2119).

( ) T301: Sonar transformer (#52-194).

( ) RY301: Be sure the relay lugs are straight. Then mount the relay at RY301 as shown. Be sure the relay is all the way down against the circuit board before you solder the relay lugs to the foil.

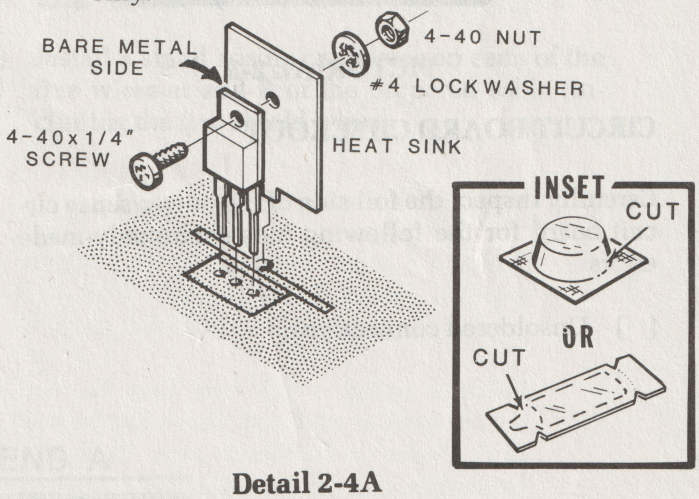


WARNING: The silicone grease you will use in the following step(s) helps transfer heat from the transistor to the heat sink. The grease is not caustic, but make sure you do not get it into your eyes, ears, nose, mouth, or clothing. Always wash your hands after you use the grease. Keep this and all chemicals out of the reach of children.

( ) Refer to the inset drawing on Detail 2-4A and open the container of silicone grease.

( ) Refer to Detail 2-4A and apply a thin layer of silicone grease to the bare metal side of a 7812 IC (#442-674). NOTE: Discard the remaining grease.

( ) Again refer to Detail 2-4A and mount the prepared 7812 IC onto a heat sink as shown. Use a 4-40 × 1/4" screw, a #4 lockwasher, and a 4-40 nut. Tighten the hardware finger tight only.



Detail 2-4A

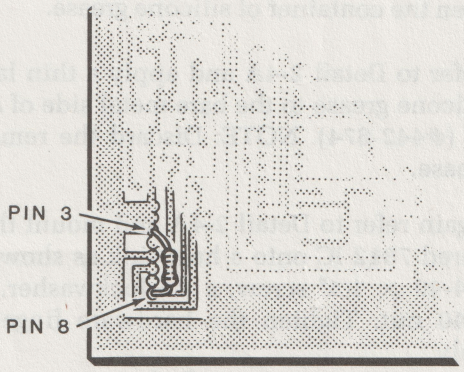
( ) U301: Position the heat sink over the long outline on the circuit board and insert the IC leads into the circuit board holes as shown. Solder the IC leads and the heat sink tab to the foils; then cut off the excess lead lengths. Tighten the IC mounting screw.

( ) Q301: In the same manner, mount a 2N6109 transistor (#417- 289) on a heat sink; then install the assembly on the circuit board at Q301 as in the previous step.

( ) L301: Mount the 650 μH choke (#46-71) on the circuit board at L301. Solder its leads to the foil and cut off any excess lead lengths.

( ) Position the circuit board on your work area with the bottom side up as shown in Pictorial 2-5. NOTE: Only the lower portion of this side of the circuit board is shown.

( ) R370: Cut both leads of a 10 MΩ (brn-blk-blu) resistor to 1/4". Then connect the resistor between plug P302/P303 pins 3 and 8.



PICTORIAL 2-5

CIRCUIT BOARD CHECKOUT

Carefully inspect the foil side of the power/sense circuit board for the following most-commonly-made errors:

( ) Unsoldered connections.

( ) Poor solder connections.

( ) Solder bridges between foil patterns.

( ) Protruding leads which could touch together.

Refer to the illustrations where parts were installed as you make the following visual checks:

( ) Check each electrolytic capacitor for the correct position of the positive (+) or negative (−) marked lead.

( ) Check each diode for the correct type and installation (correct position of the banded end).

( ) Check each transistor for the proper type and installation.

( ) Check each integrated circuit (IC) for the proper type and installation.

NOTE: Some unused holes, including the holes for R325, remain in the circuit board.

Set the completed power/sense circuit board aside until it is called for in a step.

CPU CIRCUIT BOARD

PARTS LIST

Remove the parts from Pack #3. Then check each part against the following list. Do not remove components that are supplied on a tape from the tape until you use them in a step. Return any part that is packed in an individual envelope, with the part number printed on it, back to the envelope after you identify it. Keep these parts in the envelopes until they are called for in a step. Do NOT throw away any packing material until you account for all the parts.

The key numbers correspond to the numbers on the "CPU Circuit Board Parts Pictorial" (Illustration Booklet, Page 6).

To order a replacement part, always include the PART NUMBER. Use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of this Manual. For prices, refer to the separate "Heath Parts Price List."

TAPED COMPONENTS

NOTE: These parts are taped on a strip which was checked before shipment. Since these parts are taped in the order of assembly, you may not wish to check them against the following list.

RESISTORS

NOTE: The following resistors are rated at 1/4-watt and have a tolerance of 5%. A 5% tolerance is indicated by a fourth color band of gold.

HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
6-229-12	1	2.2 Ω (red-red-gld)	R231
6-511-12	2	510 Ω (grn-brn-brn)	R236, R237
6-681-12	11	680 Ω (blu-gry-brn)	R229, R235, R238, R239, R241, R242, R243, R244, R245, R246, R247
6-102-12	1	1000 Ω (brn-blk-red)	R208
6-222-12	1	2200 Ω (red-red-red)	R226

HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
6-272-12	1	2700 Ω (red-viol-red)	R223
6-472-12	3	4700 Ω (yel-viol-red)	R205, R227, R232
6-562-12	1	5600 Ω (grn-blu-red)	R233
6-103-12	12	10 kΩ (brn-blk-org)	R201, R202, R203, R207, R209, R214, R216, R217, R225, R228, R249, R261
6-153-12	1	15 kΩ (brn-grn-org)	R259
6-473-12	5	47 kΩ (yel-viol-org)	R206, R251, R253, R255, R257
6-683-12	2	68 kΩ (blu-gry-org)	R218, R221
6-104-12	6	100 kΩ (brn-blk-yel)	R219, R222, R252, R254, R256, R258
6-154-12	1	150 kΩ (brn-grn-yel)	R211
6-274-12	1	270 kΩ (red-viol-yel)	R213

CAPACITORS

HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
21-763	2	330 pF (331) glass ceramic	C224, C225
21-762	4	.1 µF (104) glass ceramic	C215, C217, C223, C230

DIODES

HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
56-56	3	1N4149	D201, D202, D203

NON-TAPED PARTS

The following parts are not taped on strips (except for the .01 µF glass ceramic capacitors, which are packed in a separate envelope). The key numbers correspond to the numbers on the "CPU Circuit Board Parts Pictorial" (Illustration Booklet, Page 6).

CAPACITORS

Ceramic

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
A1	21-757	1	22 pF	C227
A1	21-743	2	27 pF	C202, C203
A1	21-75	1	100 pF (100K)	C236
A1	21-46	1	.005 µF	C226
A2	21-761	26	.01 µF (103) glass	C204, C205, C206, C207, C208, C209, C210, C211, C212, C213, C214, C218, C219, C221, C222, C244, C245, C246, C247, C248, C249, C251, C252, C253, C254, C255

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
A1	21-143	1	.05 µF	C239

Electrolytic

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
A3	25-924	1	2.2 µF	C238
A3	25-879	2	4.7 µF polarized	C201, C216
A4	25-907	1	4.7 µF nonpolarized	C235
A3	25-917	1	10 µF	C237
A3	25-905	4	470 µF	C232, C233, C241, C242

Other Capacitors

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
A5	20-115	1	300 pF mica	C231
A6	27-85	1	.22 µF Mylar	C234
A6	27-86	1	.47 µF Mylar	C229
A7	31-57	1	2.7-20 pF trimmer	C228

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.

TRANSISTORS-INTEGRATED CIRCUITS (ICs)

NOTE: Transistors and integrated circuits may be marked for identification in one of the following four ways:

1. Part number.
2. Type number. (For integrated circuits, this refers only to the numbers and letters shown in **bold** print in the Parts List. Disregard any other numbers or letters on the IC.)
3. Part number and type number.
4. Part number with a type number other than the one listed.

B1	417-801	7	MPSA20 transistor	Q202, Q203, Q204, Q206, Q207, Q208, Q209
B1	417-865	1	MPSA55 transistor	Q205
B1	417-875	1	2N3904 transistor	Q201
B2	442-762	1	LM388N-1 IC	U224
B3	442-603	1	78M05 IC	U209
B2	443-995	1	SC-01-A IC	U223
B2	443-1014	2	68A21 IC	U214, U215
B2	443-779	1	74LS02 IC	U211
B2	443-797	1	74LS10 IC	U212
B2	443-791	3	74LS244 IC	U225, U227, U228
B2	443-885	1	74LS245 IC	U226
B2	443-887	1	4023 IC	U222
B2	443-1155	1	4069 IC	U221
B2	443-1027	1	6116 IC	U203
B2	443-939	1	6808 IC	U201
~~B2~~	~~443-1139~~	~~1~~	~~146818 IC~~	~~U213~~
B2	444-254-1	1	16k × 8-bit ROM	U208
B2	444-283-1	1	16k × 8-bit ROM	U207
B2	444-295	1	Address decoder	U202
B4	100-1852	1	IC Assembly	U213

CONNECTORS

C1	432-903	1	10-pin plug	P203
C2	432-946	2	25-pin plug	P201, P205
C3	432-1041	8	2-hole jumper socket	
C4	432-1130	3	6-pin plug	J202, J204, J206
C5	432-1149	3	8-pin plug	P204, SW201 (2)
C6	432-1265	6	3-pin plug	J201, J203, J205, J207, P202, P206
C7	434-253	3	40-pin IC socket	
C7	434-298	6	14-pin IC socket	
C7	434-299	2	16-pin IC socket	
C7	434-307	3	24-pin IC socket	
C7	434-311	6	20-pin IC socket	
C7	434-312	5	28-pin IC socket	
C7	434-339	1	22-pin IC socket	

MISCELLANEOUS

D1	1-70	1	22 MΩ (red-red-blu) 1/2-watt, 10%, resistor	R212
D2	10-312	1	10 kΩ control	R224
D2	10-390	1	20 kΩ control	R234
D3	45-47	1	2 mH RF choke	L203
D4	235-229	3	35 uH RF choke	L201, L202, L205
D5	404-536	1	4 MHz crystal	Y201
D6	404-624	1	32.768 kHz crystal	Y202

PART FROM THE FINAL PACK

	85-2984-1	1	CPU circuit board

STEP-BY-STEP ASSEMBLY

Refer to Pictorial 3-1 (Illustration Booklet, Page 7) for the following steps.

( ) Locate the "Taped Component Chart" for Pack #3 and follow the instructions on the top of the Chart for Pack #1 before you continue with the following steps.

( ) Position the CPU circuit board as shown in the Pictorial.

IMPORTANT: The "Circuit Component Number" for each of the .01 µF glass ceramic capacitors is preceded by an asterisk (*). Be sure you locate these capacitors in their separate envelope.

Section 1

( ) R202: 10 kΩ (brn-blk-org).

( ) R203: 10 kΩ (brn-blk-org).

( ) R201: 10 kΩ (brn-blk-org).

( ) *C244: .01 µF (103) glass ceramic.

( ) *C210: .01 µF (103) glass ceramic.

( ) *C211: .01 µF (103) glass ceramic.

Install nine 680 Ω (blu-gry-brn) resistors at the following locations:

( ) R238.

( ) R239.

( ) R241.

( ) R242.

( ) R243.

( ) R244.

( ) R245.

( ) R246.

( ) R247.

( ) Solder the leads to the foil and cut off the excess lead lengths.

Section 2

( ) *C213: .01 µF (103) glass ceramic.

( ) *C222: .01 µF (103) glass ceramic.

( ) R233: 5600 Ω (grn-blu-red).

( ) R217: 10 kΩ (brn-blk-org).

( ) R222: 100 kΩ (brn-blk-yel).

( ) R221: 68 kΩ (blu-gry-org).

( ) R216: 10 kΩ (brn-blk-org).

( ) R219: 100 kΩ (brn-blk-yel).

( ) R218: 68 kΩ (blu-gry-org).

( ) D202: 1N4149 diode (#56-56). Be sure to position the banded end as shown.

( ) R225: 10 kΩ (brn-blk-org).

( ) Solder the leads to the foil and cut off the excess lead lengths.

Section 3

( ) *C208: .01 µF (103) glass ceramic.

( ) *C209: .01 µF (103) glass ceramic.

( ) *C206: .01 µF (103) glass ceramic.

( ) *C252: .01 µF (103) glass ceramic.

( ) *C253: .01 µF (103) glass ceramic.

( ) *C254: .01 µF (103) glass ceramic.

( ) R236: 510 Ω (grn-brn-brn).

( ) R237: 510 Ω (grn-brn-brn).

( ) R226: 2200 Ω (red-red-red).

( ) D203: 1N4149 diode (#56-56).

( ) R223: 2700 Ω (red-viol-red).

( ) R231: 2.2 Ω (red-red-gold).

( ) R232: 4700 Ω (yel-viol-red).

( ) R229: 680 Ω (blu-gry-brn)

( ) R228: 10 kΩ (brn-blk-org).

( ) R227: 4700 Ω (yel-viol-red).

( ) Solder the leads to the foil and cut off the excess lead lengths.

Section 4

( ) *C207: .01 µF (103) glass ceramic.

( ) *C204: .01 µF (103) glass ceramic.

( ) *C205: .01 µF (103) glass ceramic.

( ) *C255: .01 µF (103) glass ceramic.

( ) *C251: .01 µF (103) glass ceramic.

( ) C215: .1 µF (104) glass ceramic.

( ) C217: .1 µF (104) glass ceramic.

( ) R235: 680 Ω (blu-gry-brn).

( ) Solder the leads to the foil and cut off the excess lead lengths.

Section 5

( ) C230: .1 µF (104) glass ceramic.

( ) R213: 270 kΩ (red-viol-yel).

( ) R208: 1000 Ω (brn-blk-red).

( ) R209: 10 kΩ (brn-blk-org).

( ) R214: 10 kΩ (brn-blk-org).

( ) *C218: .01 µF (103) glass ceramic.

( ) R257: 47 kΩ (yel-viol-org).

( ) R258: 100 kΩ (brn-blk-yel).

( ) R256: 100 kΩ (brn-blk-yel).

( ) R255: 47 kΩ (yel-viol-org).

( ) R253: 47 kΩ (yel-viol-org).

( ) R254: 100 kΩ (brn-blk-yel).

( ) R252: 100 kΩ (brn-blk-yel).

( ) R251: 47 kΩ (yel-viol-org).

( ) R259: 15 kΩ (brn-grn-org).

( ) D201: 1N4149 diode (#56-56).

( ) C225: 330 pF (331) glass ceramic.

( ) R207: 10 kΩ (brn-blk-org).

( ) R205: 4700 Ω (yel-viol-red).

( ) R206: 47 kΩ (yel-viol-org).

( ) R249: 10 kΩ (brn-blk-org).

( ) Solder the leads to the foil and cut off the excess lead lengths.

Section 6

( ) R212: 22 MΩ, 1/2-watt (red-red-blu). NOTE: This resistor is not on the "Taped Component Chart."

( ) R211: 150 kΩ (brn-grn-yel).

( ) *C221: .01 µF (103) glass ceramic.

( ) *C219: .01 µF (103) glass ceramic.

( ) *C246: .01 µF (103) glass ceramic.

( ) *C248: .01 µF (103) glass ceramic.

( ) *C249: .01 µF (103) glass ceramic.

( ) C223: .1 µF (104) glass ceramic.

( ) R261: 10 kΩ (brn-blk-org).

( ) *C212: .01 µF (103) glass ceramic.

( ) *C214: .01 µF (103) glass ceramic.

( ) *C247: .01 µF (103) glass ceramic.

( ) *C245: .01 µF (103) glass ceramic.

( ) C224: 330 pF (331) glass ceramic.

( ) Solder the leads to the foil and cut off the excess lead lengths.

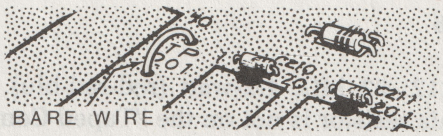
Refer to Pictorial 3-2 (Illustration Booklet, Page 8) for the following steps.

NOTE: As you install each component in this Pictorial, solder its leads to the foil and, if applicable, cut off the excess lead lengths.

( ) Y201: Bend the leads of the 4 MHz crystal (#404-536) 90 degrees. Then mount the crystal on the circuit board over the outline at Y201.

( ) Prepare a 2″ bare wire by removing the insulation from a length of blue wire. Then cut the bare wire into two 1″ lengths.

( ) TP201: Bend one of these 1″ wires into a looped arch as shown. Install this wire at TP201 on the circuit board so the top of the loop is 1/4″ above the circuit board.



( ) Similarly, install the other 1″ bare wire at TP203 on the circuit board. NOTE: Be sure to use the correct holes.

Mount IC sockets on the circuit board as you did before. Be sure all the pins are straight on a socket before you install it and solder the pins to the foil.

( ) 40-pin socket at U201.

Install a 20-pin IC socket at each of the following four locations:

( ) U226.

( ) U228.

( ) U227.

( ) U202.

Install a 28-pin IC socket at each of the following five locations:

( ) U208.

( ) U207.

( ) U205.

( ) U204.

( ) U203.

( ) U225: 20-pin IC socket.

( ) U223: 22-pin IC socket.

Install a 14-pin IC socket at each of the following five locations:

( ) U224.

( ) U222.

( ) U212.

( ) U211.

( ) U221.

( ) U213: 24-pin IC socket.

( ) U216: 24-pin IC socket.

( ) U215: 40-pin IC socket.

( ) U214: 40-pin IC socket.

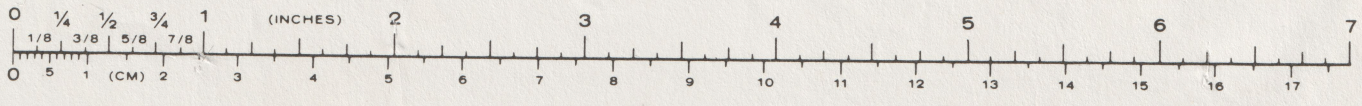
( ) U218: 16-pin IC socket.

( ) U217: 16-pin IC socket.

( ) U219: 14-pin IC socket.

( ) U206: 24-pin IC socket.

( ) U229: 20-pin IC socket.



Refer to Pictorial 3-3 (Illustration Booklet, Page 9) for the following steps.

NOTES:

1. When you are instructed to remove a pin from a circuit board plug in any of the following steps, count from either end of the plug and, using long-nose pliers, pull the pin from the plug. When you install the plug on the circuit board, note the numbering on the plug outline; then place the open space on the prepared plug at the proper location, counting from the pin 1 end.

2. As you install each part or component called for on this Pictorial, solder its leads to the foil and, if applicable, cut off the excess lead ends.

( ) P205: Pull pin 9 from a 25-pin circuit board plug. Then carefully install the plug at P205 on the left side of the circuit board. Count from the lower (pin 1) end of the plug and make sure the space where you removed the pin is at the pin 9 location.

( ) P204: Pull pin 2 from an 8-pin plug. Then, taking the same care as in the preceding step, install the plug at P204.

( ) P203: Pull pin 1 from a 10-pin plug and install the plug at P203.

Install a 6-pin plug at each of the following three locations:

( ) J206.

( ) J204.

( ) J202.

Install a 3-pin plug at each of the following six locations:

( ) P206.

( ) J205.

( ) J203.

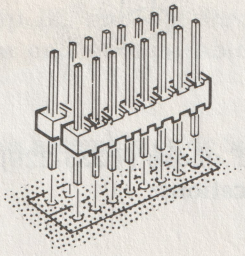
( ) J201.

( ) P202.

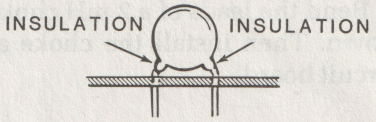
( ) J207.

( ) P201: 25-pin plug. Pull pin 12 from this plug; then be sure to install this plug with the space at the pin 12 location.

( ) SW201: Install two 8-pin plugs, side-by-side at SW201, as shown.



NOTE: When you install ceramic capacitors in the following steps, do not push the insulated portions of the leads into the circuit board holes. This could make it difficult to solder the leads to the foil.



( ) C202: 27 pF ceramic.

( ) C203: 27 pF ceramic.

( ) C239: .05 µF ceramic.

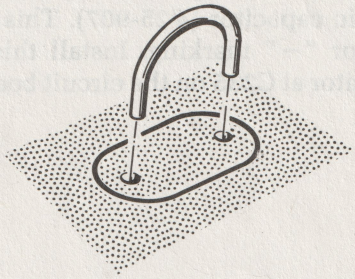
( ) C236: 100 pF (100k) ceramic.

( ) C231: 300 pF mica.

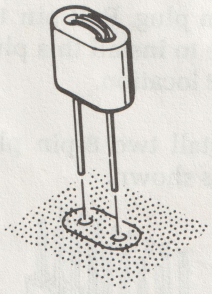
( ) C226: .005 µF ceramic.

( ) C227: 22 pF ceramic.

( ) L204: Prepare a 3/4″ bare wire by removing the insulation from a length of blue wire. Bend this wire into a U as shown. Then install this wire at L204 on the circuit board.



NOTE: When you install chokes in the following steps, be sure to push the choke all the way down against the top of the circuit board.



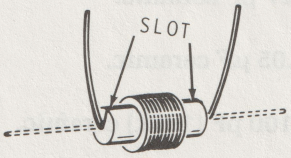
Install a 35 µH RF choke (#235-229) at each of the following three locations:

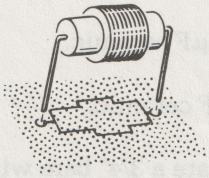
( ) L202.

( ) L205.

( ) L201.

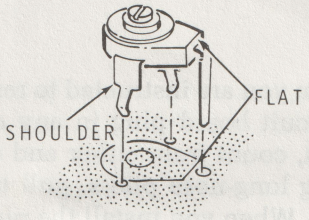
( ) L203: Bend the leads of a 2 mH choke (#45-47) as shown. Then install the choke at L203 on the circuit board.



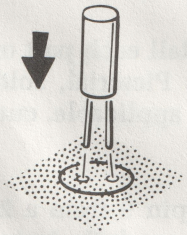


( ) C235: Locate nonpolarized (N-P) 4.7 µF electrolytic capacitor (#25-907). This part has no "+" or "−" marking. Install this horizontal capacitor at C235 on the circuit board.

( ) C228: 2.7-20 pF trimmer (#31-57). Install this trimmer at C228 on the circuit board as shown.



( ) Y202: Install a 32.768 kHz crystal (#404-624) at Y202 on the circuit board as shown.



Refer to Pictorial 3-4 (Illustration Booklet, Page 10) for the following steps.

NOTES:

1. When you install integrated circuits in the following steps, several of the sockets will remain empty in order to accommodate optional RAMs, ROMs, and EPROMs as they become available.

2. Before you proceed with the following steps, again refer to Figure 4 (Illustration Booklet, Page 5) and read the important information regarding the handling of static-sensitive devices.

Install the following ICs in the designated sockets:

( ) U201: 6808 IC (#443-939).

( ) U226: 74LS245 IC (#443-885).

( ) U228: 74LS244 IC (#443-791).

( ) U227: 74LS244 IC (#443-791).

( ) U202: Address decoder (#444-295).

( ) U208: 16K × 8-bit ROM (#444-254).

( ) U207: 16K × 8-bit ROM (#444-283).

( ) U225: 74LS244 IC (#443-791).

( ) U223: SC-01-A IC (#443-995).

( ) U224: LM388N-1 IC (#442-762).

( ) U222: 4023 IC (#443-887).

( ) U212: 74LS10 IC (#443-797).

( ) U211: 74LS02 IC (#443-779).

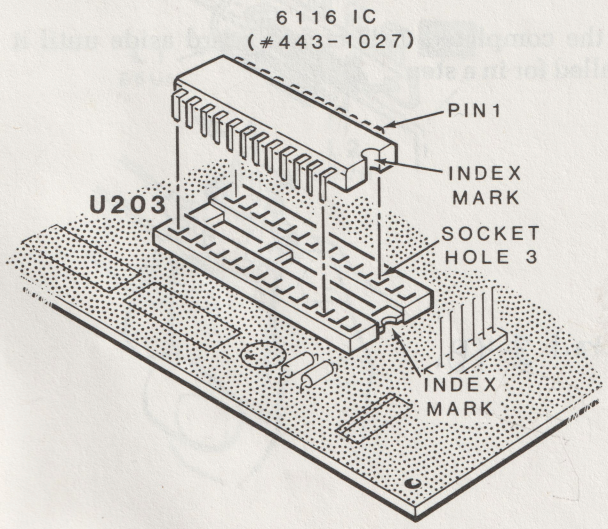
( ) U221: 4069 IC (#443-1155).

( ) U213: 146818 IC (#443-1139).

( ) U215: 68A21 IC (#443-1014).

( ) U214: 68A21 IC (#443-1014).

( ) U203: Refer to Detail 3-4A and mount a 6116 IC (#443-1027) in the socket at U203 as follows: After you are sure that all the IC pins are straight, push the IC into holes **3 through 26** as shown. Be sure that **pin 1** is in **socket hole 3**.



Detail 3-4A

NOTE: When you install transistors in each of the following steps, be sure to position the flat on the transistor over the outline of the flat on the circuit board, as you did previously.

Install a MPSA20 transistor (#417-801) at each of the following seven locations:

( ) Q203.

( ) Q202.

( ) Q204.

( ) Q208.

( ) Q209.

( ) Q207.

( ) Q206.

( ) Q205: MPSA55 transistor (#417-865).

( ) Q201: 2N3904 transistor (#417-875).

NOTE: When you install an electrolytic capacitor, as in the following step, always match the negative (−) mark on the capacitor with the negative (−) mark on the circuit board, OR match the positive (+) mark on the capacitor with the positive (+) mark on the circuit board.

( ) C216: 4.7 µF electrolytic.

( ) C238: 2.2 µF electrolytic.

( ) C241: 470 µF electrolytic.

( ) C233: 470 µF electrolytic.

( ) C232: 470 µF electrolytic.

( ) C237: 10 µF electrolytic.

( ) C242: 470 µF electrolytic.

( ) C234: .22 µF Mylar.

( ) C229: .47 µF Mylar.

( ) Solder the leads to the circuit board and cut off the excess lead lengths.

NOTE: When you install the IC in the following step, be sure you position the bare metal back on the device over the double lines on the circuit board.

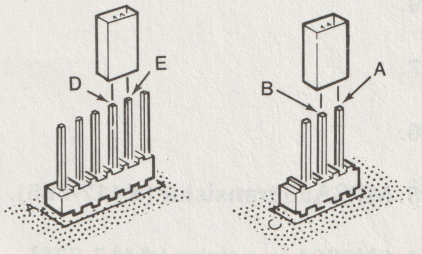
( ) U209: 78M05 IC (#442-603). Solder the leads to the foil and cut off the excess lead lengths.

( ) R224: 10 kΩ control (#10-312).

( ) R234: 20 kΩ control (#10-390).

( ) Solder the control lugs to the foil.

Place 2-hole jumper sockets on the following plug pins, as shown below and in the Pictorial:



6-PIN PLUG 3-PIN PLUG

( ) Pins D-E on J206.

( ) Pins D-E on J204.

( ) Pins D-E on J202.

( ) Pins B-A on J205.

( ) Pins B-A on J203.

( ) Pins B-A on J201.

( ) Pins B-A on J207.

( ) The "9600" on 16-pin array SW201.

( ) U213: IC Assembly (#100-1852). Refer to Detail 3-4B.

CIRCUIT BOARD CHECKOUT

Carefully inspect the unlettered side of the CPU circuit board for the following most-commonly-made errors:

( ) Unsoldered connections.

( ) Poor solder connections.

( ) Solder bridges between foil patterns.

( ) Protruding leads which could touch together.

Refer to the illustrations where parts were installed as you make the following visual checks:

( ) Check each electrolytic capacitor for the correct position of the positive (+) and negative (−) marked lead.

( ) Check each diode for the correct type and installation (correct position of the banded end).

( ) Check each transistor for the proper type and installation.

( ) Check each integrated circuit (IC) for the proper type and installation.

NOTE: There are some unused holes in the circuit board.

Set the completed CPU circuit board aside until it is called for in a step.

CHASSIS

PARTS LIST

Unpack the remainder of the kit and check each part against the following list. The key numbers correspond to the numbers on the "Chassis Parts Pictorial" (Illustration Booklet, Pages 11 through 14). Return any part that is packed in an envelope, with the part number printed on it, back to the envelope after you identify it. Keep these parts in the envelopes until they are called for in a step. Do NOT throw away any packing material until all of the parts are accounted for.

To order a replacement part, always include the PART NUMBER. Use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of this Manual. For prices, refer to the separate "Heath Parts Price List."

ELECTRONIC COMPONENTS

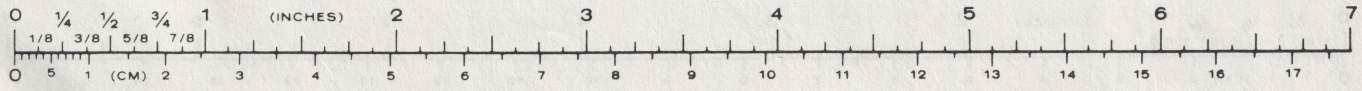
KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
A1	1-185-12	1	1.8 MΩ (brn-gry-grn), 1/4-watt, 5% resistor	R1
A2	9-67	1	Photo resistor	LDR1
A3	21-21	2	200 pF ceramic capacitor	C1, C2
A4	27-85	1	.22 µF Mylar capacitor	C3
A5	45-62	2	26 µH RF choke	L1, L2
A6	60-20	1	9-lug slide switch	SW2
A7	60-601	1	3-lug slide switch	SW1
A8	150-131	1	Optical switch	A3
A9	235-282	1	Battery charger	
A10	235-302	1	8-ohm speaker	SP2
A11	401-163	1	45-ohm speaker	SP1
A12	418-45	2	6-volt battery	B1, B2
A13	420-640	1	Steering motor	A1
A14	420-648	1	Drive motor	A2
A15	421-5	1	4-ampere, 3AG, slow-blow fuse	F1
A16	473-35	1	Sonar transducer	A4
A17	475-18	1	Ferrite core	FB1

HARDWARE

NOTE: Hardware packets are marked to show the size of the hardware they contain (HDW #4 or HDW #6, etc.). You may have to open more than one packet to locate all of the hardware of any one size (#6, for example).

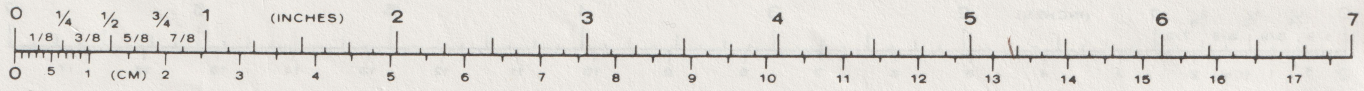
#4 Hardware

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
B1	250-1411	12	4-40 × 1/4" screw	
B2	250-1412	2	4-40 × 3/8" screw	
B3	252-2	3	4-40 nut	
B4	252-731	4	4-40 brass press-in nut	
B5	254-9	13	#4 lockwasher	
B6	255-804	5	4-40 × 1" spacer	



KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
#6 Hardware				
C1	250-1325	4	6-32 × 1/4″ screw	
C2	250-1264	34	6-32 × 3/8″ hex head screw	
C3	250-1423	2	6-32 × 3/8″ flat head screw	
C4	250-475	19	#6 × 3/8″ hex head, sheet metal screw	
C5	250-1430	2	6-32 × 1/2″ screw	
C6	250-1297	2	6-32 × 1-3/4″ screw	
C7	252-3	29	6-32 nut	
C8	252-769	4	6-32 wing nut	
C9	252-725	14	6-32 brass press-in nut	
C10	253-2	4	#6 fiber shoulder washer	
C11	253-89	2	#6 D-washer	
C12	254-1	31	#6 lockwasher	
C13	259-1	3	#6 solder lug	
#8 Hardware				
D1	250-1481	1	8-32 setscrew pin	
D2	250-1485	2	8-32 × 1/4″ setscrew	
D3	250-1437	2	8-32 × 1/2″ screw	
D4	254-2	2	#8 lockwasher	
#10 Hardware				
E1	250-1441	4	10-32 × 1/2″ screw	
E2	252-5	4	10-32 nut	
E3	254-3	8	#10 lockwasher	
Other Hardware				
F1	250-1500	2	3/8-16 × 2-1/2″ screw	
F2	252-56	4	3/8-16 nut	
F3	252-751	1	1/2-13 nut	
F4	253-10	4	Flat washer	
F5	254-45	2	1/2″ split lockwasher	
F6	254-5	4	3/8″ lockwasher	
F7	255-820	1	1-17/32″ long spacer	
F7	255-831	1	1-21/32″ long spacer	
F8	258-6	2	Contact spring	
F9	258-~~756~~ 770	1	Retaining spring	
F10	258-767	1	Door spring	
F11	262-50	4	Tapered pin (hex shoulder)	
F12	262-57	4	Tapered pin (plain)	
F13	452-28	1	Drive pin	
F14	453-339	1	Drive shaft	

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
GASKETS-GROMMETS				
G1	73-4	8	7/16″ rubber grommet	
G2	73-44	3	7/8″ plastic grommet	
G3	73-47	2	Square rubber gasket	
G1	73-59	1	3/8″ rubber grommet	
G4	73-180	3	1-1/4″ rubber grommet	
G5	73-195	1	Double-stick gasket	
TERMINAL STRIPS				
H1	431-11	1	5-lug terminal strip	
H2	431-14	2	2-lug terminal strip	
H3	431-86	1	6-lug terminal strip	
CONNECTORS				
J1	432-66	6	Large push-on connector (inclues 1 extra)	
J2	432-803	2	Large 3-pin socket shell	
J3	432-865	5	Small 3-pin socket shell	
J4	432-866	40	Small spring connector (includes 2 extra)	
J5	432-924	1	4-pin plug	P3
J6	432-970	1	5-pin socket shell	
J7	432-1030	1	2-pin socket shell	
J8	432-1099	1	4-pin power socket	J1
J9	432-1100	1	4-pin power plug	P1
J10	432-1151	2	4-pin socket shell	
J11	432-1283	4	6-pin socket shell	
J12	432-1324	6	Large spring connector	
J13	432-1406	2	Small push-on connector	
METAL PARTS				
K1	200-1483	1	Battery holder	
K2	203-2113-4	2	Body side panel	
K3	203-2241	1	Front subpanel	
K4	203-2205	1	Rear subpanel	
K5	204-135	1	Angle bracket	
K6	204-2840	2	Battery retainer bracket	
K7	204-2644	1	Support bracket	
K8	204-2741	1	Drive motor bracket	
K9	204-2743	1	Speaker bracket	
K10	204-2744	1	Front head mounting bracket	
K11	204-2746-1	1	Connector bracket	
K12	204-2808	1	Battery bracket	
K13	204-2809	1	Front wheel bracket	
K14	204-2821	1	Rear head mounting bracket	
K15	204-2822	1	Cartridge guide	
K16	205-1883-1	1	Encoder disk	
K17	205-1925	1	Base plate	
K18	205-1948	1	Head plate	



Heathkit®

MISCELLANEOUS

KEY No.	HEATH Part No.	QTY.	DESCRIPTION	CIRCUIT Comp. No.
L1	73-201	1	U-shaped gasket	
L2	92-834	1	Head panel	
L3	95-664	2	Body section	
L4	203-2240	1	Access door	
L5	207-3	1	Small cable clamp	
L6	207-18	1	Large cable clamp	
L7	208-50	7	Cable clip	
L8	261-41	2	Plastic foot	
L9	354-5	5	Cable tie	
L10	422-1	1	Fuse block	
L11	438-55	6	Polarizing pin	
L12	446-749	1	Window	
L13	456-48	1	Shoulder bushing	
L14	485-35	1	Hole cover	
L15	490-5	1	Nut starter	
L16	490-85	1	Allen wrench	
L17	490-191	1	Adjustment tool	
L18	655-~~17~~ 21	3	Wheel	

STEP-BY-STEP ASSEMBLY

BASE ASSEMBLY

Refer to Pictorial 4-1 (Illustration Booklet, Page 14) for the following steps.

( ) Position the base plate as shown in the Pictorial so the side flanges are down.

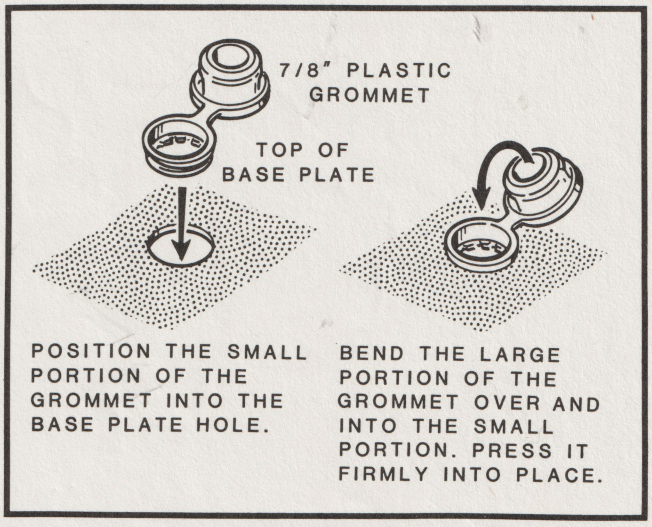
( ) Refer to Detail 4-1A and install a 7/8″ plastic grommet in hole BA of the base plate.

( ) Similarly, install a 7/8″ plastic grommet in hole BB of the base plate.

NOTES:

1. When a step calls for hardware, only the screw size is given. If a step calls for "6-32 × 3/8″ hex head hardware", for example, it means you should use a 6-32 × 3/8″ hex head screw, one or more #6 lockwashers, and a 6-32 nut. The Detail referred to in the step or the Pictorial shows the correct number of lockwashers and their proper use.

2. Use the plastic nut starter supplied with this kit to hold and start 4-40 and 6-32 nuts on screws.


7/8″ PLASTIC GROMMET
TOP OF BASE PLATE
POSITION THE SMALL PORTION OF THE GROMMET INTO THE BASE PLATE HOLE.
BEND THE LARGE PORTION OF THE GROMMET OVER AND INTO THE SMALL PORTION. PRESS IT FIRMLY INTO PLACE.

Detail 4-1A

( ) A3: Refer to Detail 4-1B and use the following procedure to mount the optical switch (#150-131) onto the front wheel bracket:

1. Use 4-40 × 3/8″ hardware to mount the optical switch onto the indicated side of the angle bracket as shown in Part A of the Detail. Be sure the symbols on the sensor are ~~toward the angle bracket~~ as shown. Tighten the hardware finger tight.

2. Adjust the angle bracket so the indicated end of the bracket is 1/16″ away from the rear edge of the optical switch as shown. Then tighten the hardware. Do NOT overtighten the hardware or you could break the optical switch.

3. Use 4-40 × 3/8″ hardware to mount the angle bracket onto the front wheel bracket at BL as shown in Part B of the Detail. Push the bracket as far as possible in the direction of the arrow before you tighten the hardware.

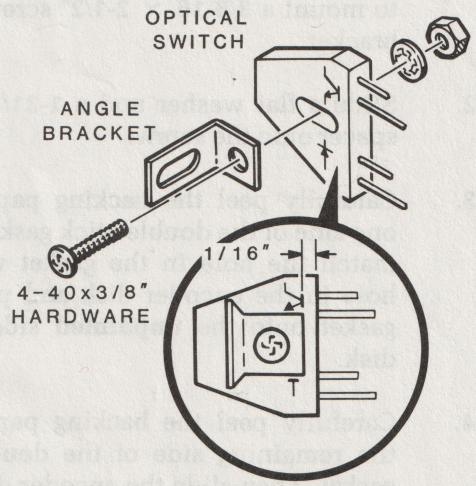
4. Check the distance from the front edge of the optical switch to the front wheel bracket. This distance should be 1/4″. Loosen the optical switch-mounting hardware and reposition the optical switch as necessary. NOTE: You can use the LED spacer (set aside when you assembled the keyboard circuit board) to check this distance as shown in the inset drawing on Part B of the Detail.

( ) Position the front wheel bracket against the bottom of the base plate as shown (note the location of the rectangular cutout in the bracket). Then use 6-32 × 3/8″ hex head hardware to mount the bracket to the base plate at the seven indicated locations. Also be sure to mount a 6-lug terminal strip at BC as shown. Be sure to position the terminal strip as shown in the Pictorial before you tighten the hardware.

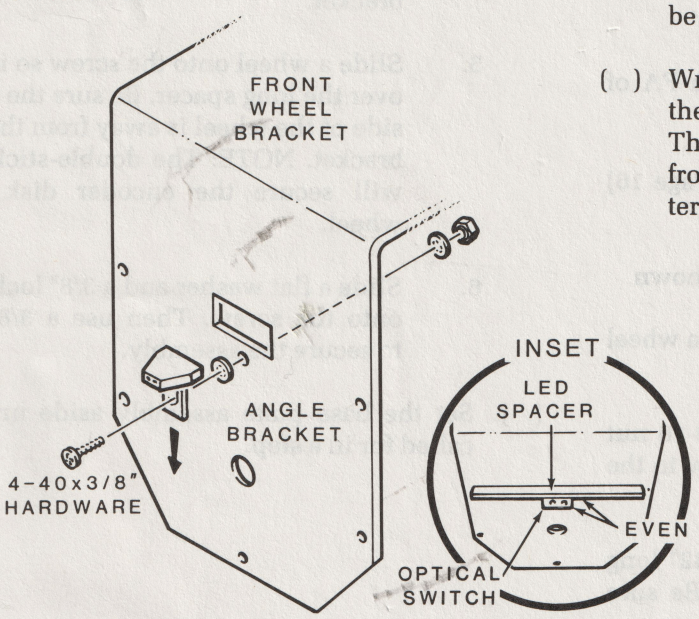
( ) Carefully peel the backing paper from two square rubber gaskets. Then press the gaskets onto the battery holder as shown in the inset drawing on the Pictorial.

( ) Use 6-32 × 3/8″ hex head hardware to mount the battery holder to the front wheel bracket at the three indicated locations on each side of the bracket.

PART A



PART B



Detail 4-1B

Refer to Pictorial 4-2 (Illustration Booklet, Page 15) for the following steps.

( ) Reposition the base plate assembly as shown.

( ) Use 6-32 × 1/2″ hardware to mount a 2-lug terminal strip and the fuse block to the base plate at BL. Be sure to position the terminal strip and the fuse block as shown in the Pictorial before you tighten the hardware.

( ) Use 6-32 × 3/8″ hex head hardware to mount a 2-lug terminal strip and a #6 solder lug to the base plate at BF. Be sure to position the terminal strip and solder lug as shown before you tighten the hardware.

( ) Use 6-32 × 3/8″ hex head hardware to mount the battery bracket to the front wheel bracket at the four indicated locations. Push the battery bracket down as indicated by the arrows on the Pictorial before you tighten the hardware.

( ) Carefully peel the backing paper from two plastic feet. Then press a foot onto the indicated side of each battery retainer bracket.

( ) Use 6-32 × 3/8″ hex head screws to mount the battery retainer brackets onto the battery bracket at BD and BE. Tighten these screws only finger tight at this time (the batteries will be installed later).

( ) Write "4 AMPERES, 3AG, SLOW-BLOW" on the fuse replacement label in the blank space. Then carefully peel away the backing paper from the label and press the label onto the battery bracket in the area shown.

Refer to Pictorial 4-3 (Illustration Booklet, Page 15) for the following steps.

( ) Reposition the base plate assembly as shown.

( ) A1: Use four #10 lockwashers and four 10-32 nuts to mount the steering motor (#420-640) to the base plate at A1. NOTE: The motor will fit into the base plate holes in the correct position only.

( ) Use two #6 × 3/8″ hex head, sheet metal screws to mount the rear subpanel to the rear edge of the base plate as shown. Be sure to position the subpanel as shown in the Pictorial.

( ) Carefully peel the backing paper from the FCC label. Then press the label onto the rear subpanel in the area shown.

( ) Carefully peel the backing paper from the blue and white label. Then press the label onto the rear subpanel so it is just below the FCC label. NOTE: Refer to the numbers on this label in any correspondance you may have with the Heath Company about your kit.

( ) Use two #6 × 3/8″ hex head, sheet metal screws to mount the front subpanel to the base plate as shown. Be sure to position the subpanel so hole FA is down toward the base plate.

( ) Install a 7/8″ plastic grommet in hole FA of the front subpanel.

Refer to Pictorial 4-4 (Illustration Booklet, Page 16) for the following steps.

( ) Reposition the base plate assembly as shown.

( ) Use the following procedure to mount a wheel onto the front wheel bracket at BG:

1. Use a 3/8″ lockwasher and a 3/8-16 nut to mount a 3/8-16 × 2-1/2″ screw to the bracket.

2. Slide a flat washer and a 1-17/32″ long spacer onto the screw. NOTE: Be sure to use the shortest of the two spacers.

3. Slide a wheel onto the screw so it passes over the long spacer. Be sure the 6-spoke side of the wheel is away from the wheel bracket.

4. Slide a flat washer and a 3/8″ lockwasher onto the screw. Then use a 3/8-16 nut to secure the assembly.

( ) Use the following procedure to mount a wheel onto the front wheel bracket at BH:

1. Use a 3/8″ lockwasher and a 3/8-16 nut to mount a 3/8-16 × 2-1/2″ screw to the bracket.

2. Slide a flat washer and a 1-21/32″ long spacer onto the screw.

3. Carefully peel the backing paper from one side of the double-stick gasket. Then match the hole in the gasket with the hole in the encoder disk and press the gasket onto the **unpainted** side of the disk.

4. Carefully peel the backing paper from the remaining side of the double-stick gasket. Then slide the encoder disk onto the screw and long spacer so the painted side of the disk is toward the wheel bracket.

5. Slide a wheel onto the screw so it passes over the long spacer. Be sure the 6-spoke side of the wheel is away from the wheel bracket. NOTE: The double-stick gasket will secure the encoder disk to the wheel.

6. Slide a flat washer and a 3/8″ lockwasher onto the screw. Then use a 3/8-16 nut to secure the assembly.

( ) Set the base plate assembly aside until it is called for in a step.

Refer to Pictorial 4-5 (Illustration Booklet, Page 17) for the following steps.

( ) Use a 4-40 nut, two #4 lockwashers, and a 4-40 × 1″ spacer to mount two contact springs onto the support bracket as shown. Be sure to position the contact springs as shown before you tighten the hardware.

( ) Use 6-32 × 3/8″ hex head hardware to mount the support bracket to the drive motor bracket at DA. Be sure the holes at DB line up before you tighten the hardware. A cable clamp will be mounted at DB later.

( ) Use 6-32 × 3/8″ hex head hardware to mount the shoulder bushing onto the top of the drive motor bracket as shown. Be sure to mount the bushing so the setscrew holes are in the positions shown.

( ) Use 6-32 × 3/8″ hex head hardware to mount a 5-lug terminal strip onto the drive motor bracket at DD as shown. Be sure to position the terminal strip as shown in the Pictorial before you tighten the hardware.

Refer to Pictorial 4-6 (Illustration Booklet, Page 17) for the following steps.

NOTE: The drive motor that you received is one of two different types. When you mount the motor in the next step, use the holes in the drive motor bracket that best match the mounting holes of your motor. Also use either 8-32 or 10-32 screws as required by your particular motor. Also, your motor may require four screws or only two.

( ) A2: Mount the drive motor (#420-648) to the drive motor bracket as shown. Use 8-32 × 1/2″ screws and #8 lockwashers **OR** use 10-32 × 1/2″ screws and #10 lockwashers. Be sure to mount the motor on the correct side of the bracket as shown.

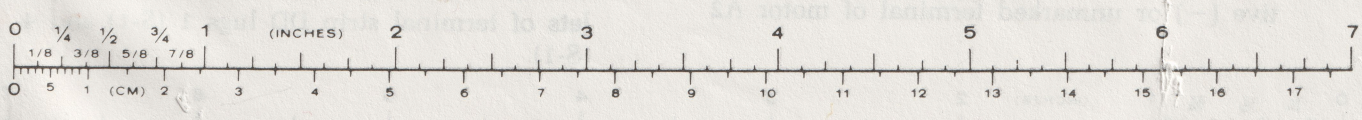
Refer to Pictorial 4-7 (Illustration Booklet, Page 18) for the following steps.

( ) Use the following procedure to mount the drive shaft onto the drive motor:

1. Use the allen wrench to start an 8-32 × 1/4″ setscrew into the threaded hole of the drive shaft.
2. Slide the drive shaft onto the shaft of the drive motor so the hole that goes all the way through the drive shaft lines up with the hole in the motor shaft.
3. Push the drive pin all the way into the holes in the shafts. Then tighten the setscrew.

( ) Use the following procedure to mount a wheel onto the drive shaft:

1. Slide a 1/2″ split washer onto the drive shaft.
2. Slide a wheel onto the drive shaft so the side with the six ribs is **away** from the drive motor.
3. Slide a 1/2″ split lockwasher onto the drive shaft. Then use a 1/2-13 nut to secure the assembly. Be sure this nut is tight.



Refer to Pictorial 4-8 (Illustration Booklet, Page 18) for the following steps.

NOTES:

1. In the following steps, (NS) means not to solder the connection because you will add other wires later. "S-" with a number, such as (S-2), means to solder the connection. The number following the "S-" tells you how many wires should be at the connection. This helps you check your work for errors as you go.

2. When a step directs you to prepare a **stranded** wire, cut the wire to the indicated length and remove 1/4″ of insulation from each end. Then tightly twist together the wire strands at each end and melt a very small amount of solder on these ends to hold the fine strands together.

( ) Cut a 41″ length of 3-wire cable (without shield) and remove 1-1/4″ of outer insulation from each end of the cable. Then prepare the end of each wire at both ends of the cable.

Connect one end of the prepared cable to terminal strip DD as follows:

( ) Black wire to lug 1 (S-1).

( ) Red wire to lug 2 (S-1).

( ) Green wire to lug 3 (NS).

( ) Route the 3-wire cable as shown. Then use a small cable clamp, a #6 D-washer, and 6-32 × 1/2″ hardware to secure the cable at DB. Be sure to position the cable clamp as shown in the Pictorial before you tighten the hardware.

( ) Form the 3-wire cable into a 2″ circle as shown in the Pictorial. Then install a cable tie around the cable and through hole DE in the drive motor bracket. Leave the cable tie fairly loose so the cable can move. Cut off the excess cable tie.

( ) Prepare a 6″ black wire (stranded) and a 6″ red wire (stranded). Use these wires in the next two steps.

( ) Connect one end of the black wire to the negative (−) or unmarked terminal of motor A2 (S-1). The other end of this wire will be connected later.

( ) Connect one end of the red wire to the positive (+) or red dot marked terminal of motor A2 (S-1). The other end of this wire will be connected later.

Loosely twist together (approximately one-turn-per-inch) the red and black wires coming from motor A2. Then connect the free ends of these wire to terminal strip DD as follows:

( ) Red wire to lug 5 (NS).

( ) Black wire to lug 4 (NS).

NOTE: Refer to inset drawing #1 on the Pictorial when you connect the capacitors in the next three steps.

( ) C1: Cut both leads of a 200 pF ceramic capacitor to 1/2″. Then connect the capacitor between terminal strip DD lugs 3 (NS) and 5 (NS).

( ) C2: Cut both leads of a 200 pF ceramic capacitor to 1/2″. Then connect the capacitor between terminal strip DD lugs 3 (S-3) and 4 (NS).

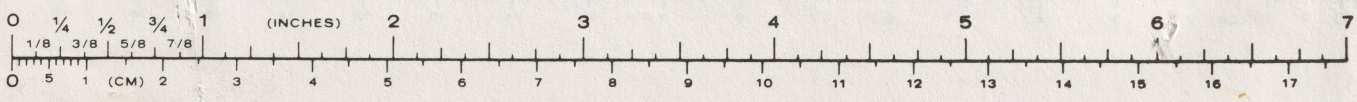
( ) C3: Cut both leads of a .22 μF Mylar capacitor to 1/2″. Then connect the capacitor between terminal strip DD lugs 4 (S-3) and 5 (S-3).

NOTE: Refer to inset drawing #2 on the Pictorial when you install the RF chokes in the next two steps. Position the chokes alongside terminal strip DD as shown so their bodies do not touch the terminal strip or the drive motor bracket.

( ) Cut two 1″ lengths of large heat-shrinkable sleeving. NOTE: You will use these lengths of sleeving in the next two steps.

( ) L1: Cut both leads of a 26 μH RF choke (#45-62) to 1/2″. Then slide a 1″ length of sleeving over the choke and connect it between the **eyelets** of terminal strip DD lugs 2 (S-1) and 5 (S-1).

( ) L2: Cut both leads of a 26 μH RF choke (#45-62) to 1/2″. Then slide a 1″ length of sleeving over the choke and connect it between the **eyelets** of terminal strip DD lugs 1 (S-1) and 4 (S-1).



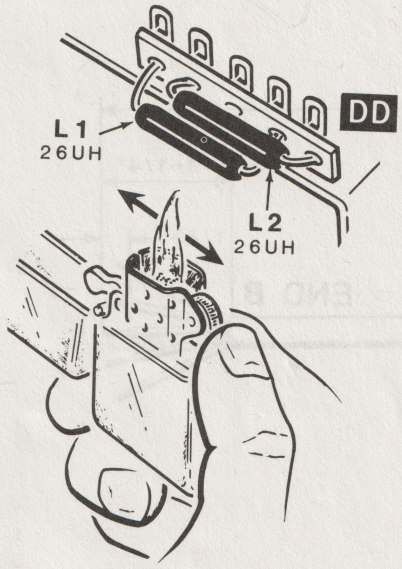
Refer to Pictorial 4-9 (Illustration Booklet, Page 19) for the following steps.

( ) Start an 8-32 × 1/4″ setscrew into the indicated hole of the shoulder bushing on the drive motor bracket.

( ) If necessary, insert the blade of a small screwdreiver or other similar tool into the hole in the motor shaft, and turn the shaft so its flat side is positioned as shown in the Pictorial.

( ) Slide the shoulder bushing on the drive motor bracket onto the shaft of the steering motor so the indicated hole in the bushing lines up with the hole in the motor shaft. Then insert the pin end of the 8-32 setscrew pin into the remaining bushing setscrew hole and into the hole in the motor shaft. Now tighten the setscrew pin. Also tighten the 8-32 × 1/4″ setscrew.

( ) Wind the 3-wire cable around the shaft of steering motor A1 so it forms a 1″ circle as shown. Then route the 3-wire cable up through grommet BA in the base plate, under terminal strip BC, and out through grommet FA in the front subpanel. The free ends of this cable will be connected later.

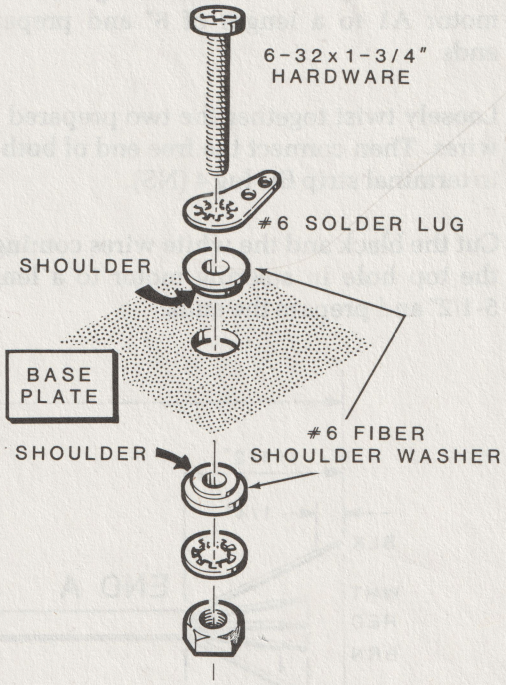


Detail 4-9A

( ) Refer to Detail 4-9A and use the heat of a match or candle to shrink the sleeving against the two RF chokes.

( ) Refer to Detail 4-9B and mount a #6 solder lug to the base plate at BJ as shown. Use 6-32 × 1-3/4″ hardware and two #6 fiber shoulder washers. Be sure the shoulders on the washers enter the base plate hole. Also be sure to position the solder lug as shown in the Pictorial before you tighten the hardware.

( ) Similarly, mount a #6 solder lug to the base plate at BK. Use 6-32 × 1-3/4″ hardware and two #6 fiber shoulder washers. Be sure to position the solder lug as shown in the Pictorial before you tighten the hardware.



Detail 4-9B

Refer to Pictorial 4-10 (Illustration Booklet, Page 19) for the following steps.

( ) Refer to the inset drawing on Pictorial 4-10 as you locate the wires coming from the bottom hole (the hole closest to the base plate) of steering motor A1. Then cut the black and white wires to a length of 6″ (from the point where they exit the motor) and prepare the ends.

Loosely twist together the prepared motor wires (approximately one turn per inch). Then connect the free ends of these wires to terminal strip BC as follows:

( ) Black wire to lug 1 (NS).

( ) White wire to lug 2 (NS).

( ) Cut the two yellow wires coming from steering motor A1 to a length of 6″ and prepare the ends.

( ) Loosely twist together the two prepared motor wires. Then connect the free end of both wires to terminal strip BC lug 4 (NS).

( ) Cut the black and the white wires coming from the top hole in steering motor to a length of 5-1/2″ and prepare the ends.

Loosely twist together the prepared motor wires. Then connect the free ends of these wires to terminal strip BC as follows:

( ) Black wire to lug 5 (NS).

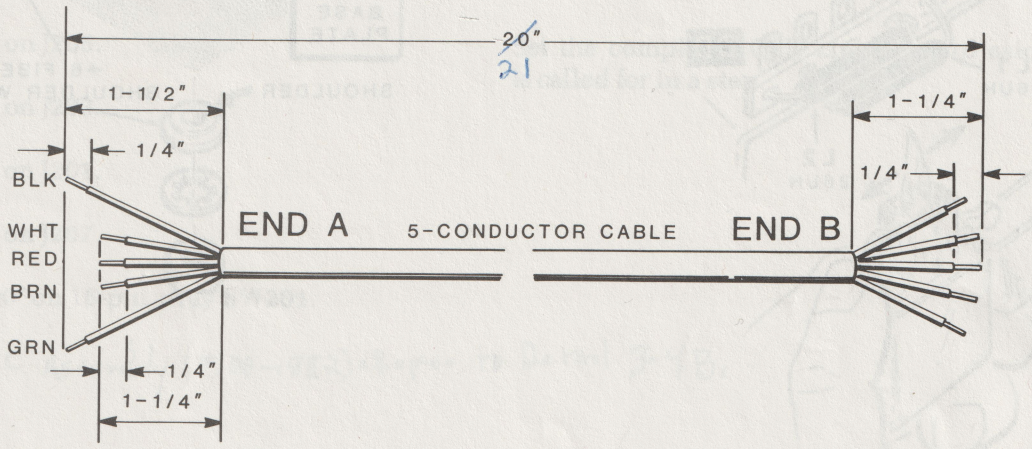
( ) White wire to lug 6 (NS).

( ) Cut a 21″ length of 5-wire cable. Then refer to Detail 4-10A and use the following procedure to prepare one end of the cable. NOTE: This end of the cable will be referred to as "end A."

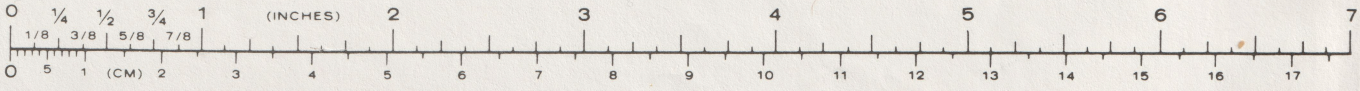
1. Remove 1-1/2″ of insulation from one end of the cable.

2. Shorten the white, red, and brown wires to the lengths indicated and prepare the ends.

( ) Remove 1-1/4″ of outer insulation from the other end of the prepared cable and prepare the ends. NOTE: This end of the cable will be referred to as "end B."



Detail 4-10A



Connect **end A** of the prepared 5-wire cable to terminal strip BC as follows:

( ) Black wire to lug 1 (S-2).

( ) White wire to lug 2 (S-2).

( ) Red wire to lug 4 (S-3).

( ) Brown wire to lug 5 (S-2).

( ) Green wire to lug 6 (S-2).

( ) Route the free end (end B) of the 5-wire cable out through grommet FA. The free end of this cable will be connected later.

( ) Cut a 28″ length of 2-wire cable. Then separate the wires at one end of the cable for 4-1/2″ and for 1-1/4″ at the other end of the cable and prepare the ends.

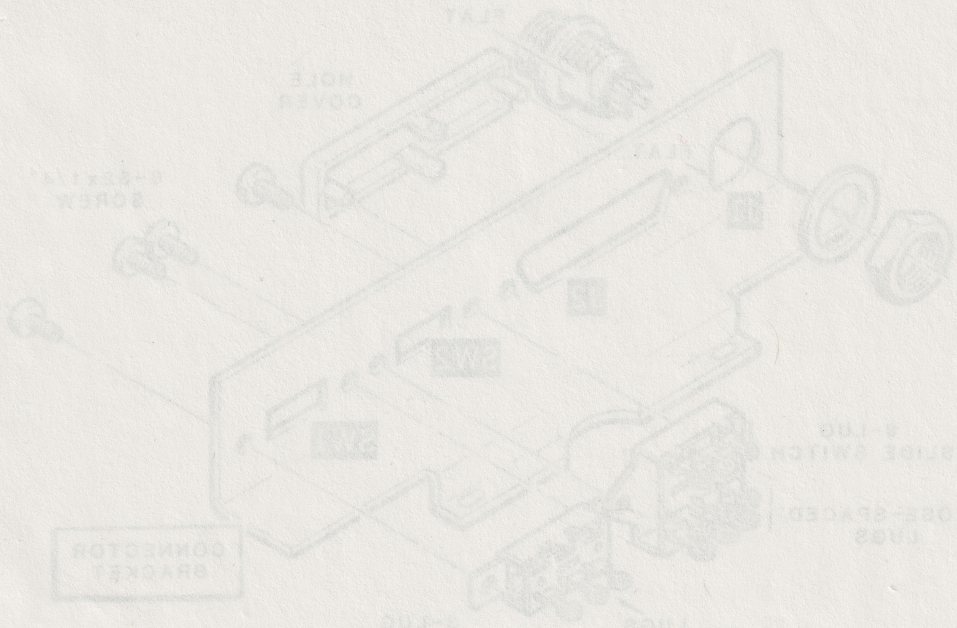
Connect the wires at the end of the 2-wire cable that is separated for 4-1/2″ as follows:

( ) Gold-colored wire to solder lug BJ (S-1).

( ) Route the silver-colored wire under the wires coming from steering motor A1. Then connect the end of this wire to solder lug BK (S-1).

( ) Route the free end of the 2-wire cable under terminal strip BC and out through grommet FA. The free end of this cable will be connected later.

( ) Set the chassis assembly aside temporarily.



HEAD PLATE ASSEMBLY

Refer to Pictorial 4-11 for the following steps.

( ) Position the connector bracket as shown in the Pictorial.

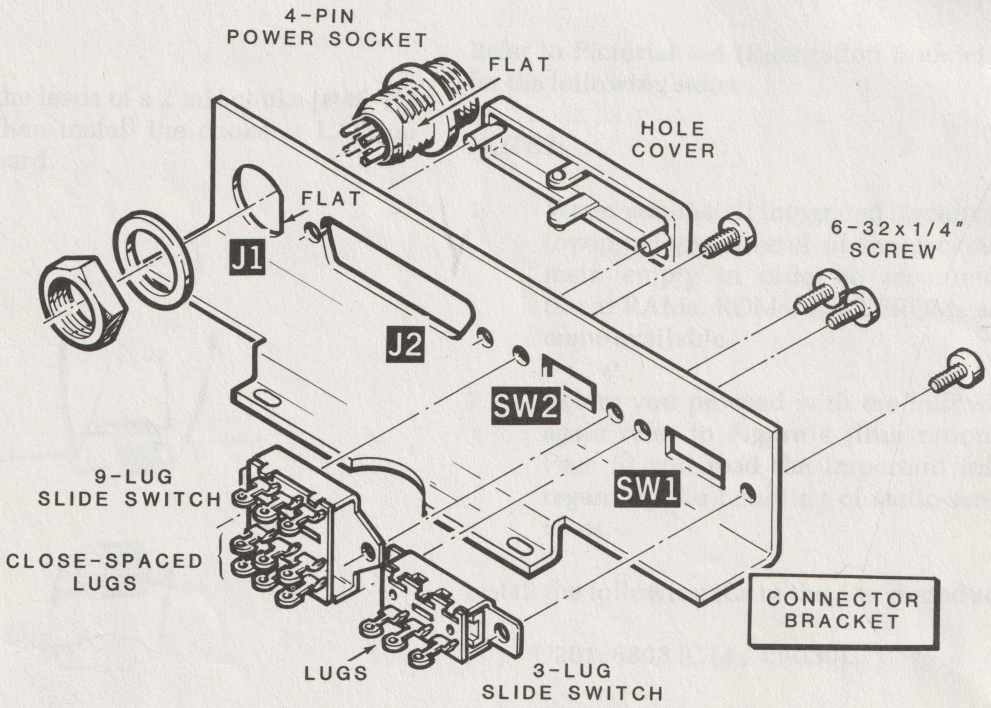
( ) J1: Use the hardware supplied with the 4-pin power socket to mount the socket to the connector bracket at J1. Be sure to match the flat on the socket with the flat in the bracket hole.

( ) Carefully snap the hole cover into hole J2 of the connector bracket. NOTE: This hole is used for one of the accessories.

( ) SW2: Use two 6-32 × 1/4" screws to mount the 9-lug slide switch to the connector bracket at SW2. Be sure to position the switch as shown so the six close-spaced lugs are toward the bottom of the bracket.

( ) SW1: Similarly, mount the 3-lug slide switch to the connector bracket at SW1. Be sure to position the switch so the lugs are toward the bottom of the bracket.

( ) Set the connector bracket aside temporarily.



PICTORIAL 4-11

Refer to Pictorial 4-12 for the following steps.

( ) Install a 1-1/4″ rubber grommet in hole HA of the head plate as shown in the inset drawing.

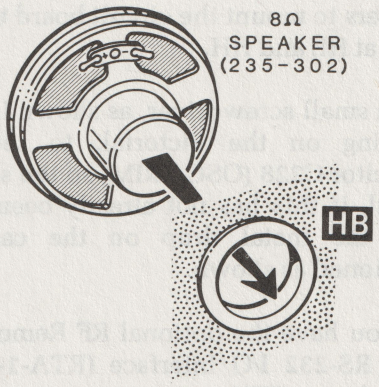
( ) Position the head plate onto the front and rear subpanels as shown. Then use three #6 × 3/8″ hex head sheet metal screws to secure the head plate to the front subpanel and two #6 × 3/8″ hex head sheet metal screws to secure the head plate to the rear subpanel.

( ) Install 1-1/4″ rubber grommets in holes HB and HC of the speaker bracket.

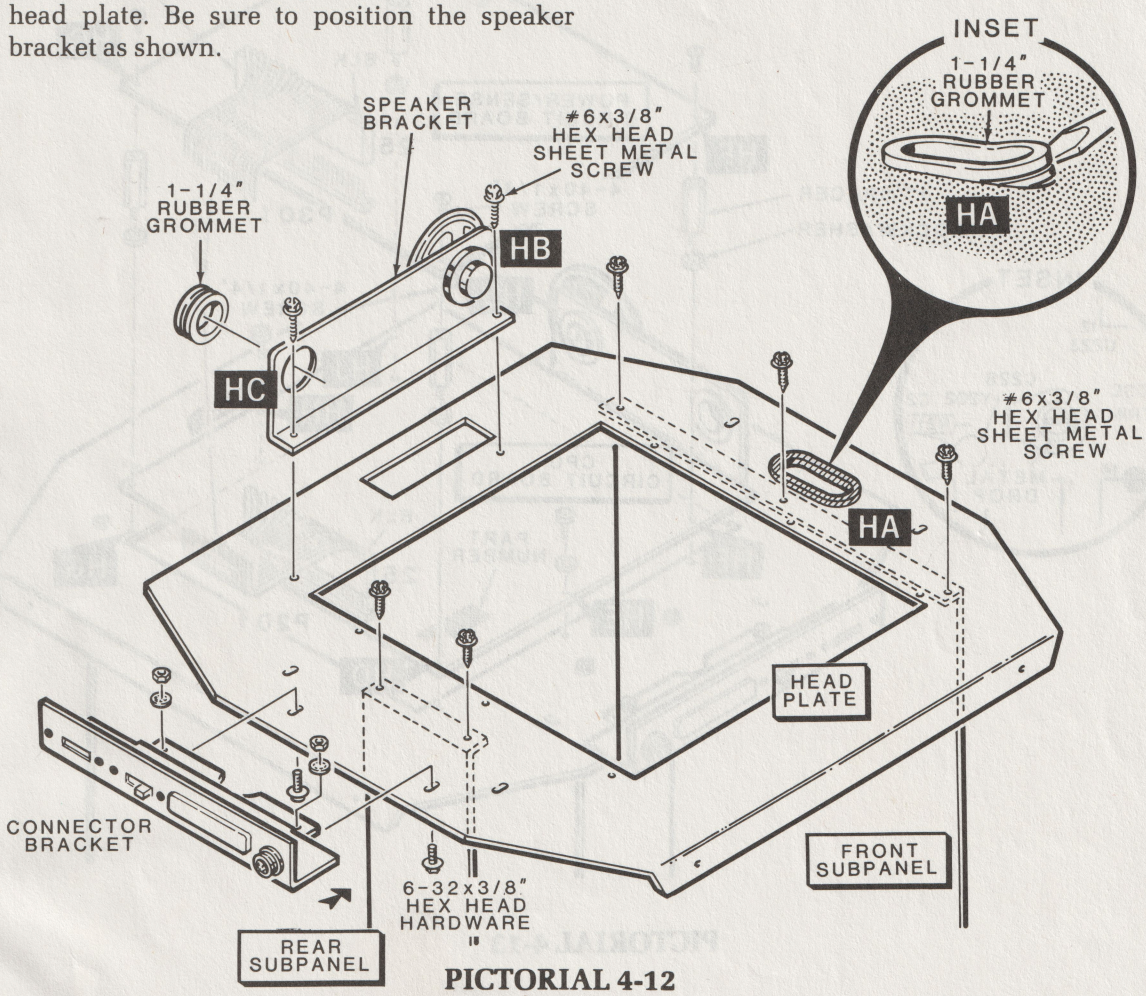
( ) SP2: Refer to Detail 4-12A, and carefully push the 8-ohm (large) speaker (#235-302) into grommet HB in the speaker bracket. Be careful not to damage the cone of the speaker. Also be sure to position the speaker so the lugs are up as shown in the Pictorial.

( ) Use two #6 × 3/8″ hex head sheet metal screws to mount the speaker bracket to the head plate. Be sure to position the speaker bracket as shown.

( ) Use 6-32 × 3/8″ hex head hardware to mount the prepared connector bracket onto the head plate as shown. Push the bracket inward (toward the center of the head plate) as far as possible; then tighten the hardware finger tight. The bracket will be readjusted later.



Detail 4-12A



PICTORIAL 4-12

Refer to Pictorial 4-13 for the following steps.

( ) Position the CPU circuit board onto the head plate as shown (note the location of the circuit board part number). Then use four #4 lockwashers and 4-40 × 1″ spacers to mount the circuit board to the head plate at HD, HF, HG, and HJ. Use 4-40 × 1/4″ screws and #4 lockwashers to mount the circuit board to the head plate at HE and HH.

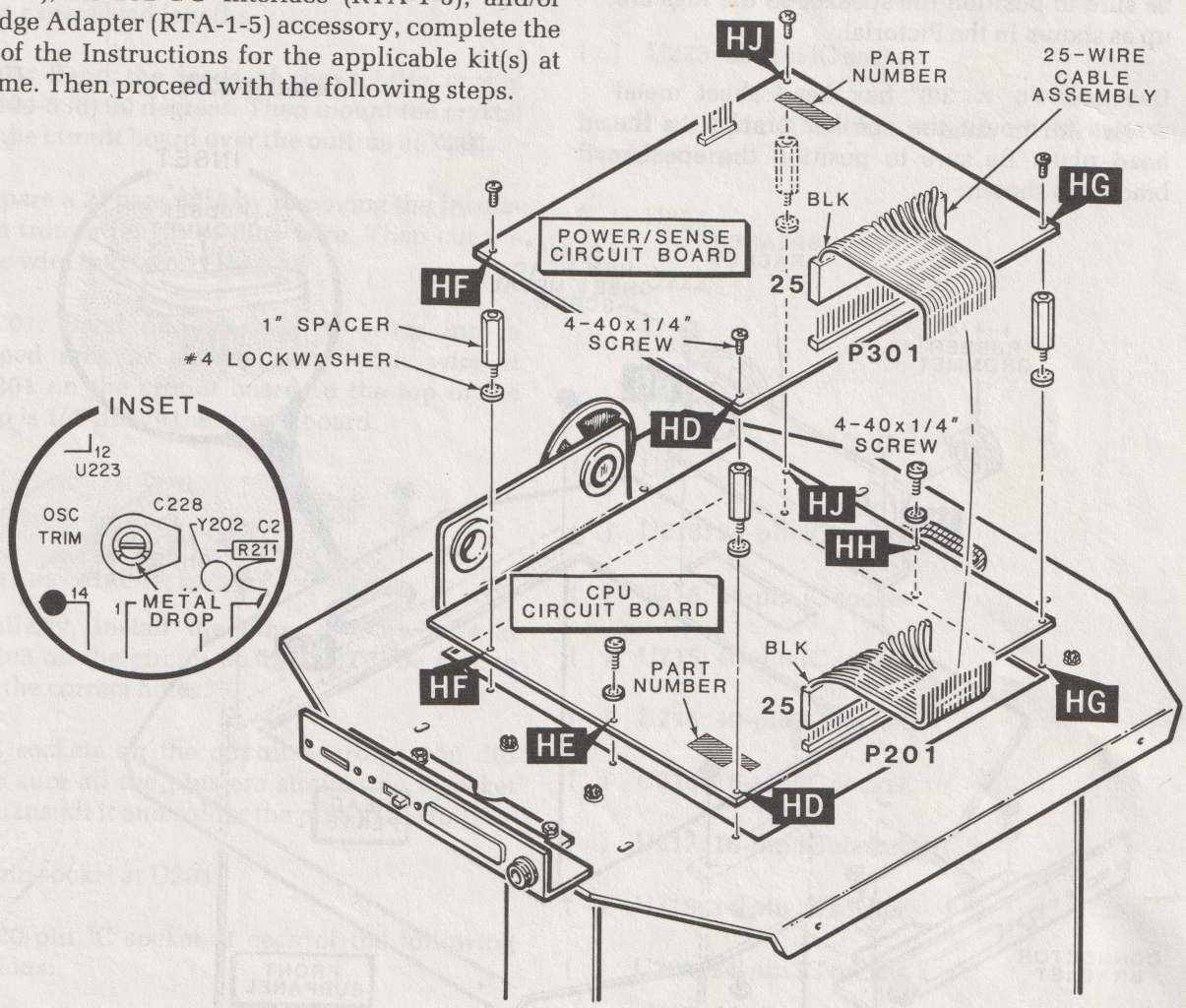
( ) Use a small screwdriver, as shown in the inset drawing on the Pictorial, to set trimmer capacitor C228 (OSC TRIM) so the slot is horizontal, if this has not already been done. Be sure the metal drop on the capacitor is positioned as shown.

NOTE: If you have the optional RF Remote Control (RTA-1-2), RS-232 I/O Interface (RTA-1-3), and/or Cartridge Adapter (RTA-1-5) accessory, complete the steps of the Instructions for the applicable kit(s) at this time. Then proceed with the following steps.

( ) Locate the 25-wire cable assembly (#134-1475) that you set aside when you assembled the keyboard. Then push the socket on one end of the cable onto plug P201 of the CPU circuit board. Be sure the black wire at one end of the socket is at plug pin 25.

( ) Position the power/sense circuit board onto the spacers at HD, HF, HG, and HJ as shown (note the location of the circuit board part number). Then use four 4-40 × 1/4″ screws to secure the circuit board to the spacers.

( ) Push the socket on the free end of the 25-wire cable assembly onto plug P301. Be sure the black wire at one end of the socket is at plug pin 25.



PICTORIAL 4-13

HEAD WIRING

Refer to Pictorial 4-14 (Illustration Booklet, Page 20) for the following steps.

( ) Carefully peel the backing paper from five cable clips. Then press the clips onto the head plate and the speaker bracket in the five areas shown (HK, HL, HN, HP, and HR). Be sure to position the open end of each clip as shown in the Pictorial.

( ) Locate the 8-wire flat cable. Then separate the green, blue, violet, and gray wires (as a group) from the other four wires. Set this 4-wire group aside for use later.

( ) Separate the remaining 4-wire cable into four separate wires. Use these wires whenever a step calls for small brown, red, orange, or yellow wires.

( ) Prepare the following wires:

6″ small red	32″ large red
3″ small yellow	16″ large white
14″ small yellow	

( ) Connect the 6″ small red wire from switch SW1 lug 2 (NS) to jack J1 lug 1 (S-1).

( ) Connect the 3″ small yellow wire from switch SW1 lug 3 (NS) to switch SW2 lug 8 (S-1).

( ) Connect one end of the 14″ small yellow wire to switch SW1 lug 3 (NS). Route the free end of this wire through clips HN, HP, and HR. The free end of this wire will be connected later.

( ) Connect one end of the 32″ large red wire to switch SW1 lug 2 (S-2). Route the free end of this wire through clips HN, HL, and HK and down through grommet HA. The free end of this wire will be connected later.

( ) Connect one end of the 16″ large white wire to switch SW1 lug 3 (S-3). Route the free end of this wire through clips HN, HP, and HR. The free end of this wire will be connected later.

( ) Locate the 4-wire (green-blue-violet-gray) cable set aside earlier. Then cut the cable to a length of 10″.

( ) Separate the wires at each end of the 10″ cable for 1-1/4″ and prepare the ends.

( ) Refer to Detail 4-14A Part A (Illustration Booklet, Page 20) and install a small spring connector on each wire at **one end** of the prepared cable.

Position a 5-pin socket shell as shown in Detail 4-14A Part B. Then insert the spring connectors into the holes of the socket shell as follows:

( ) Gray wire into hole 2.

( ) Violet wire into hole 3.

( ) Blue wire into hole 4.

( ) Green wire into hole 5.

( ) Position a polarizing pin with the small "catch" upward as shown in Detail 4-14A Part B. Then push the pin into hole 1 of the socket shell.

( ) Push the 5-pin socket shell onto CPU circuit board plug P203 pins 1 through 5. Be sure to position the socket so the polarizing pin is at plug pin 1.

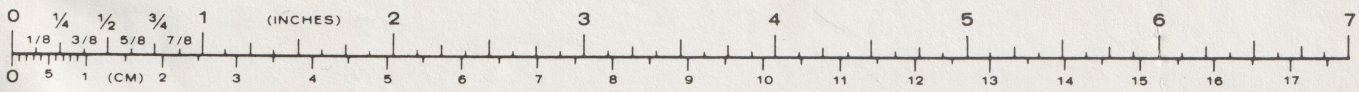
Route the free end of the 4-wire cable through clips HL and HN as shown in the Pictorial. Then connect the wires at the free end of this cable as follows:

( ) Violet wire to switch SW2 lug 1 (S-1).

( ) Blue wire to switch SW2 lug 4 (S-1).

NOTE: When a wire passes through a lug and goes on to another lug, as in the following step, it counts as two in the solder instructions; one entering and one leaving the connection.

( ) Remove an additional 1/4″ of insulation (total 1/2″) from the end of the green wire. Then connect the wire through switch SW2 lug 2 (S-2) to lug 5 (S-1).



( ) Gray wire to switch SW2 lug 9 (S-1).

( ) Locate the 2-wire cable, the 5-wire cable, and the 3-wire cable extending from the grommet in the front subpanel. Then pass the free ends of these cables up through grommet HA in the head plate.

( ) Install small spring connectors on each wire at the free end of the 2-wire cable coming from grommet HA.

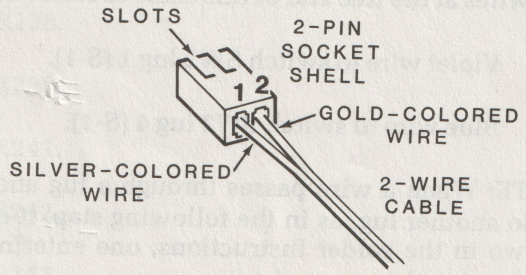
Position a 2-pin socket shell as shown in Detail 4-14B. Then insert the spring connectors on the ends of the 2-wire cable into the holes of the socket shell as follows. NOTE: To identify the wires in the next two steps, pull the insulation back away from the spring connectors enough to expose the bare wire.

( ) Silver-colored wire into hole 1.

( ) Gold-colored wire into hole 2.

( ) Route the 2-wire cable around the inside of spacer HD and through cable clip HK as shown. Then push the 2-pin socket shell onto CPU circuit board plug P203 pins 9 and 10. Be sure the slots in the side of the socket face away from the circuit board.

( ) Route the 3-wire cable coming from grommet HA around the inside of spacer HF as shown.



Detail 4-14B

( ) Refer to Detail 4-14C Part A and install a large spring connector on the end of each wire at the free end of the 3-wire cable.

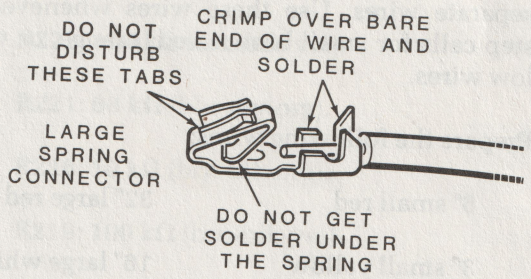
Position a large 3-pin socket shell as shown in Detail 4-14C Part B. Then push the large spring connectors on the 3-wire cable into the socket shell as follows:

( ) Red wire into hole 1.

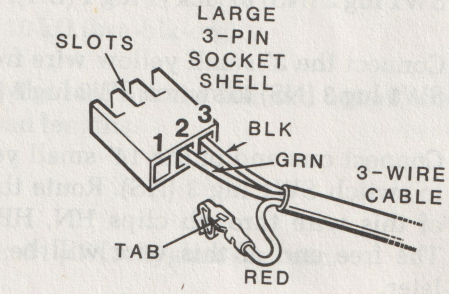
( ) Green wire into hole 2.

( ) Black wire into hole 3.

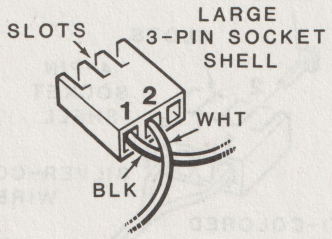
PART A


DO NOT DISTURB THESE TABS
CRIMP OVER BARE END OF WIRE AND SOLDER
LARGE SPRING CONNECTOR
DO NOT GET SOLDER UNDER THE SPRING

PART B



Detail 4-14C



Detail 4-14D

( ) Route the free end of the 3-wire cable over the top of the power/sense circuit board. Then push the socket on this cable onto plug P308. Be sure the red wire is at plug pin 1.

( ) Prepare an 18″ black wire.

( ) Install a large spring connector on one end of the prepared black wire and on the free end of the white wire coming from cable clip HR.

Position a large 3-pin socket shell as shown in Detail 4-14D. Then push the large spring connectors on the black and white wires into the socket shell as follows:

( ) White wire into hole 2.

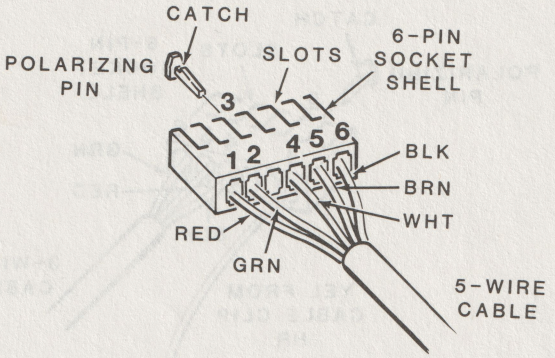
( ) Black wire into hole 1.

( ) Push the large 3-pin socket shell onto power/sense circuit board plug P310. Be sure the black wire is at plug pin 1.

( ) Route the black wire coming from the large 3-pin socket shell around the inside of spacer HF and down through grommet HA. The free end of this wire will be connected later.

( ) Route the free end of the 5-wire cable coming from grommet HA around the inside of spacer HF as shown.

( ) Install a small spring connector on each wire at the free end of the 5-wire cable coming from grommet HA.



Detail 4-14E

Position a 6-pin socket shell as shown in Detail 4-14E. Then push the spring connectors on the 5-wire cable into the socket shell as follows:

( ) Red wire into hole 1.

( ) Green wire into hole 2.

( ) White wire into hole 4.

( ) Brown wire into hole 5.

( ) Black wire into hole 6.

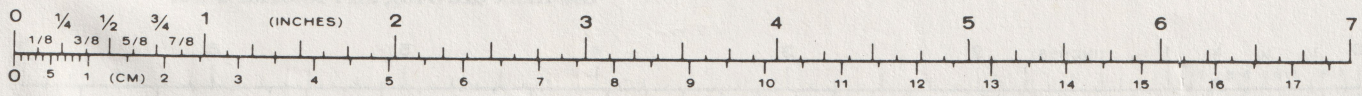
( ) Position a polarizing pin with the "catch" upward as shown in Detail 4-14E. Then push the pin into hole 3 of the socket shell.

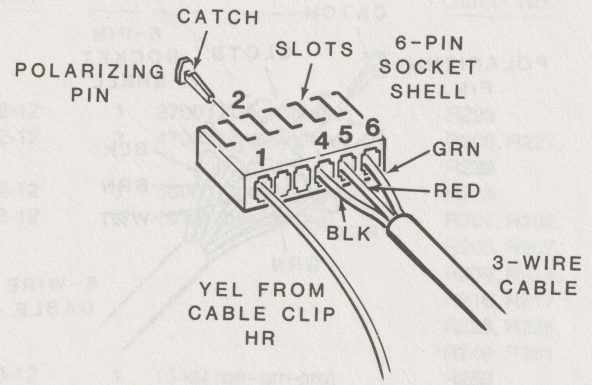
( ) Route the free end of the 5-wire cable over the top of the power/sense circuit board. Then push the socket on this cable onto plug P309. Be sure the red wire is at plug pin 1.

( ) Cut a 42″ length of 3-wire cable (without shield). Then remove 1-1/4″ of outer insulation from **one end** of the cable and prepare the end of each wire. NOTE: The other end of this cable will be prepared later.

( ) Install a small spring connector on each wire at the prepared end of the 3-wire cable.

( ) Install a small spring connector on the free end of the yellow wire coming from cable clip HR.





Detail 4-14F

( ) Position a 6-pin socket shell as shown in Detail 4-14F. Then push the spring connector on the yellow wire into hole 1.

Push the spring connectors on the end of the 3-wire cable into the socket shell as follows:

( ) Black wire into hole 4.

( ) Red wire into hole 5.

( ) Green wire into hole 6.

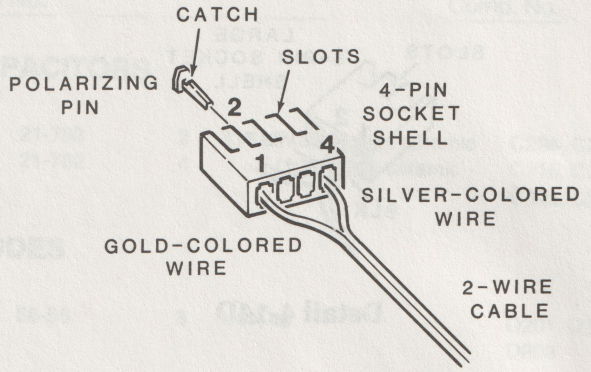
( ) Position a polarizing pin with the "catch" facing upward as shown in Detail 4-14F. Then push the pin into hole 2 of the 6-pin socket shell.

( ) Push the 6-pin socket shell onto power/sense circuit board plug P311. Be sure the yellow wire is at plug pin 1.

( ) Route the free end of the 3-wire cable through cable clips HR, HP, HL, and HK. Then route the cable around the inside of spacer HD as shown and push the end of the cable down through grommet HA. The free end of this cable will be connected later.

(✓) Cut a 35″ length of 2-wire cable. Then separate the wires at each end of the cable for 1-1/4″ and prepare the ends.

( ) Install a small spring connector on each wire at **one end** of the prepared cable.



Detail 4-14G

Position a 4-pin socket shell as shown in Detail 4-14G. Then push the spring connectors on the 2-wire cable into the holes of the socket shell as follows:

( ) Gold-colored wire into hole 1.

( ) Silver-colored wire into hole 4.

( ) Position a polarizing pin with the "catch" upwards as shown in Detail 4-14G. Then push the pin into hole 2 of the socket shell.

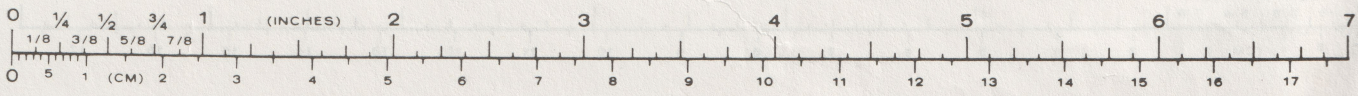
(✓) Push the 4-pin socket shell onto power/sense circuit board plug P302. Be sure to position the socket so the slotted side faces away from the circuit board.

( ) Route the free end of the 2-wire cable through cable clips HP, HL, and HK. Then route the cable around the inside of spacer HD and push the end of the cable down through grommet HA. The free end of this cable will be connected later.

( ) Prepare a 13″ small orange wire. Then install a small spring connector on **one end** of this wire.

( ) Push the spring connector on the end of the prepared orange wire into the center hole of a small 3-pin socket shell.

( ) Push the 3-pin socket shell onto CPU circuit board plug P202. Be sure the slots in the socket face away from the circuit board as shown in the inset drawing on Pictorial 4-14.



( ) Route the free end of the orange wire through cable clips HR, HP, and HN and position the end of the wire near socket J1. The end of this wire will be connected later.

( ) Cut a 20″ length of 3-wire cable with shields.

( ) Refer to Detail 4-14H Part A, and use the following procedure to prepare one end of the cable:

1. Carefully remove 3″ of outer insulation from one end of the cable. Be careful not to cut into the inner wires.

2. Cut the black wire to a length of 1-3/4″ and completely cut off the shield wires. Then prepare the ends of the wires at this end of the cable.

NOTE: This end of the cable will be referred to as "end A."

( ) Refer to Detail 4-14H Part B, and use the following procedure to prepare the other end of the cable:

1. Carefully remove 1-1/4″ of outer insulation from this end of the cable. Be careful not to nick the fine shield wires or cut into the inner wires.

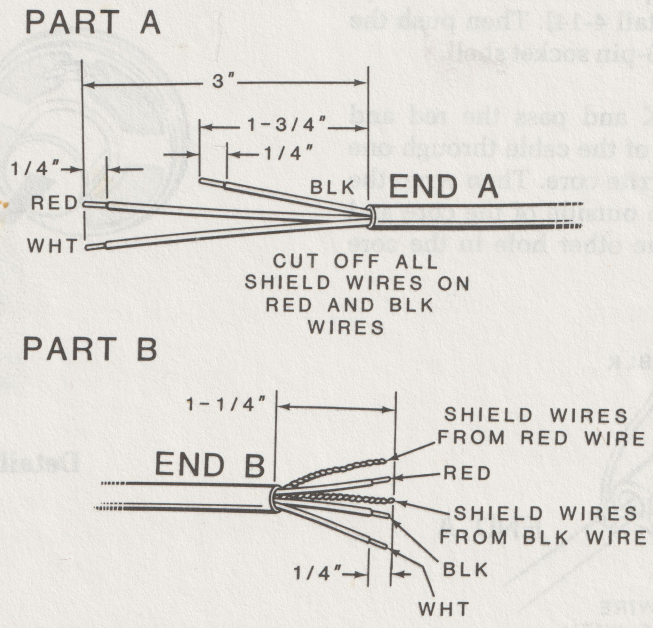
2. Unwrap the shield wires from the red wire. Then tightly twist the shield wires into a single pigtail.

3. Similarly, unwrap the shield wires from the black wire. Then tightly twist the shield wires into a single pigtail.

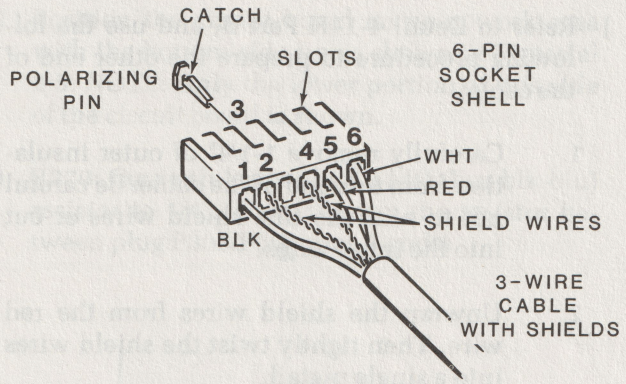
4. Prepare the ends of the red, black, white, and two shield wires.

NOTE: This end of the cable will be referred to as "end B."

( ) Install a small spring connector on each of the five wires at **end B** of the prepared cable (including the two shield wires).



Detail 4-14H



Detail 4-14J

Position a 6-pin socket shell as shown in Detail 4-14J. Then insert the spring connectors into the socket shell as follows:

( ) Black wire into hole 1.

( ) Either shield wire into hole 2.

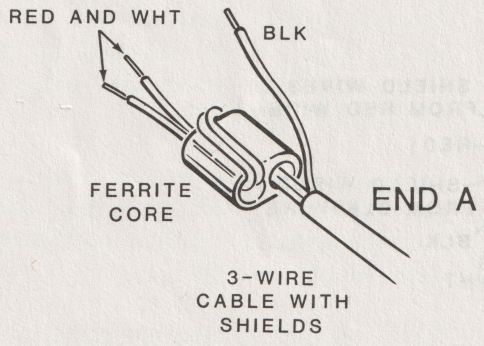
( ) Remaining shield wire into hole 4.

( ) Red wire into hole 5.

( ) White wire into hole 6.

( ) Position a polarizing pin with the "catch" upward as shown in Detail 4-14J. Then push the pin into hole 3 of the 6-pin socket shell.

( ) Refer to Detail 4-14K and pass the red and white wires at **end A** of the cable through one of the holes in the ferrite core. Then wrap the two wires around the outside of the core and pass them through the other hole in the core as shown.



Detail 4-14K

Position the ferrite core near socket J1. Then connect the wires at this end of the 3-wire cable to the socket as follows:

( ) Red wire to lug 2 (S-1).

( ) Black wire and the free end of the orange wire coming from cable clip HN to lug 4 (S-2).

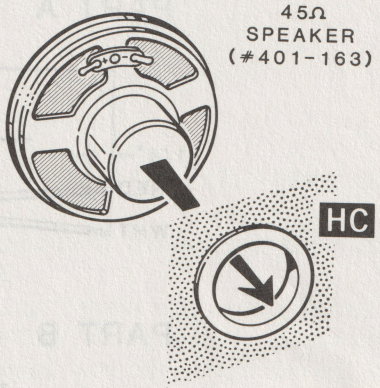
( ) White wire to lug 3 (S-1).

( ) Route the free end of the 3-wire cable (with shield) coming from socket J1 through cable clips HN, HL, and HK as shown. Then push the socket onto power/sense circuit board plug P307. Be sure the black wire is at pin 1.

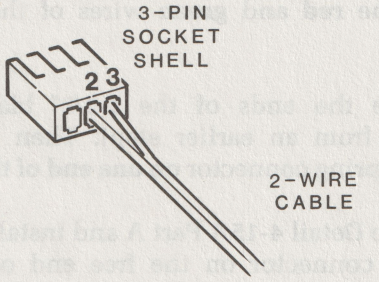
( ) SP1: Push the 45-ohm speaker (#401-163) into grommet HC in the speaker bracket. Be sure to position the speaker so the lugs are up as shown in the Pictorial.

( ) Cut a 5″ length of 2-wire cable. Then separate the wires at each end of the cable for 1-1/4″ and prepare the ends.

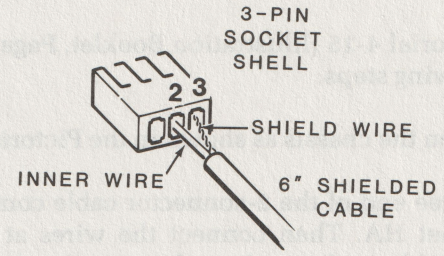
( ) Install a small spring connector on each wire at **one end** of the cable.



Detail 4-14L



Detail 4-14M



Detail 4-14P

( ) Position a 3-pin socket shell as shown in Detail 4-14M. Then push the spring connectors into holes 2 and 3 of the socket shell. It does not matter which wire goes into hole 2 and which goes into hole 3.

( ) Push the 3-pin socket shell onto CPU circuit board plug P206. Be sure to install the socket so the wires are at plug pins 2 and 3.

( ) Connect either wire at the free end of the 2-wire cable to speaker SP2 lug 1 (S-1) and the other wire to lug 2 (S-1).

( ) Cut a 6" length of shielded cable. Then refer to Detail 4-14N and prepare both ends of the cable as shown.

( ) Install a small spring connector on the inner wire and the shield wires at one end of the prepared cable.

Position a 3-pin socket shell as shown in Detail 4-14P. Then push the spring connectors on the shielded cable into the socket shell as follows:

( ) Inner wire into hole 2.

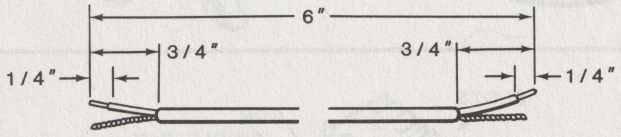
( ) Shield wire into hole 3.

( ) Push the 3-pin socket shell onto power/sense circuit board plug P304. Be sure the shield wire is at plug pin 3.

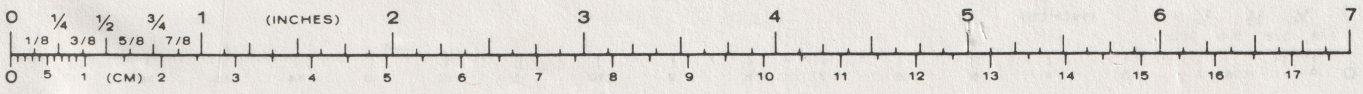
Connect the free end of the shielded cable to speaker SP1 as follows:

( ) Inner lead to the positive (+) or dot-marked lug (S-1).

( ) Shield wire to the negative (−) or unmarked lug (S-1).



Detail 4-14N



FINAL BASE WIRING

Refer to Pictorial 4-15 (Illustration Booklet, Page 21) for the following steps.

( ) Position the chassis as shown in the Pictorial.

Locate the free end of the 2-connector cable coming from grommet HA. Then connect the wires at the end of this cable to the **eyelets** of terminal strip BF as follows:

( ) Gold-colored wire to the eyelet of lug 2 (S-1).

( ) Silver-colored wire to the eyelet of lug 1 (S-1).

( ) Locate the free end of the 3-wire cable coming from grommet HA. Then pass the free end of the cable through grommet BB.

( ) Remove 2-3/4" of outer insulation from the end of the 3-wire cable. Then shorten the wires to 1-1/4" and prepare the ends. NOTE: Save the cutoff 1-1/2" black wire for use later.

( ) Install small spring connectors on the ends of only the **red** and **green** wires of the 3-wire cable.

( ) Prepare the ends of the 1-1/2" black wire (saved from an earlier step). Then install a small spring connector on **one end** of this wire.

( ) Refer to Detail 4-15A Part A and install a small spring connector on the free end of the 1" black wire and the black wire coming from the 3-wire cable.

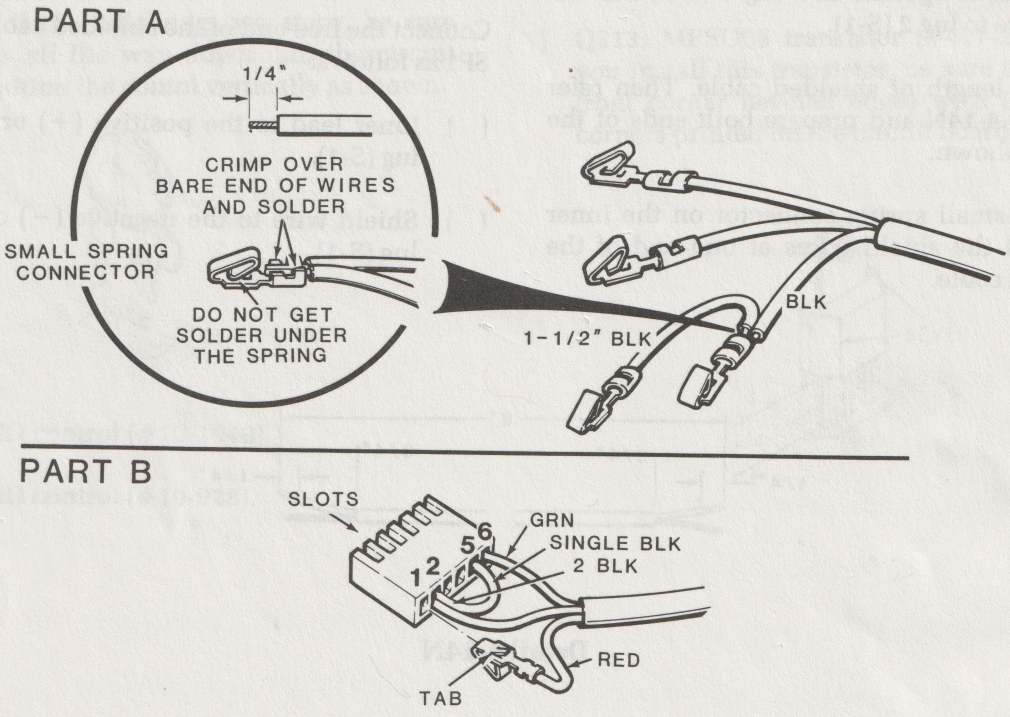
Position a 6-pin socket shell as shown in Detail 4-15A Part B. Then push the spring connectors on the ends of the 3-wire cable into the socket shell as follows:

( ) Red wire into hole 1.

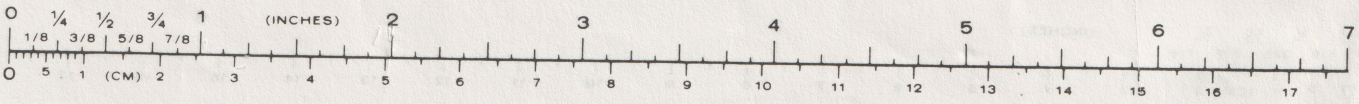
( ) Two black wires into hole 2.

( ) Single black wire into hole 5.

( ) Green wire into hole 6.



Detail 4-15A



( ) Route the socket down behind the battery bracket. Then refer to inset drawing #1 on the Pictorial and carefully push the socket onto the leads of the light sensor. Be sure the slotted side of the socket is down and the green wire is toward you as shown.

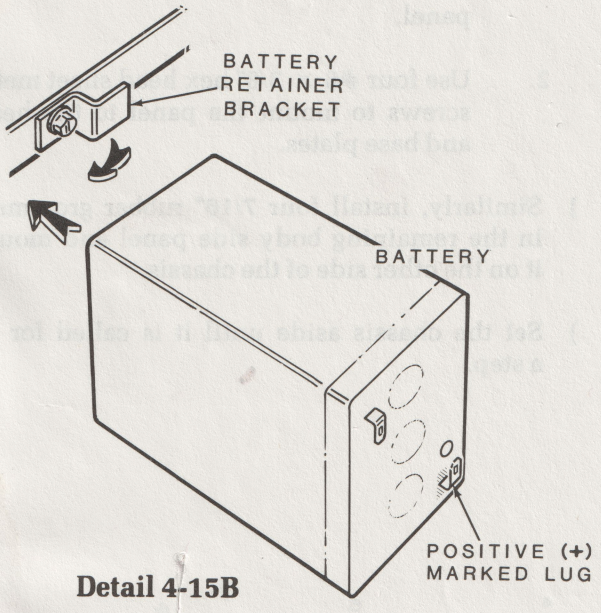
( ) Locate the single red and black wires coming from grommet HA of the head plate. Then pass the free ends of these wires through grommet BB of the base plate.

( ) Connect the free end of the black wire coming from grommet BB to solder lug BF (NS).

( ) Connect the free end of the red wire coming from grommet BB to fuse block BL lug 1 (S-1).

NOTE: You may have to loosen the hardware on the battery bracket to install the batteries in the next two steps. After you have the batteries installed, be sure the battery bracket is positioned snugly against the batteries. Then retighten the hardware.

( ) B1: Loosen the battery retainer bracket at BD. Then refer to Detail 4-15B, and position a battery into the battery bracket as shown. Be sure the positive (+) lug of the battery is positioned down as shown. Then reposition retainer bracket BD so it holds the battery into position and tighten the screw. NOTE: The positive lug may be marked with a red dot instead of a plus (+).



Detail 4-15B

( ) B2: Similarly loosen the battery retainer bracket at BE and position a battery into the battery bracket as shown.

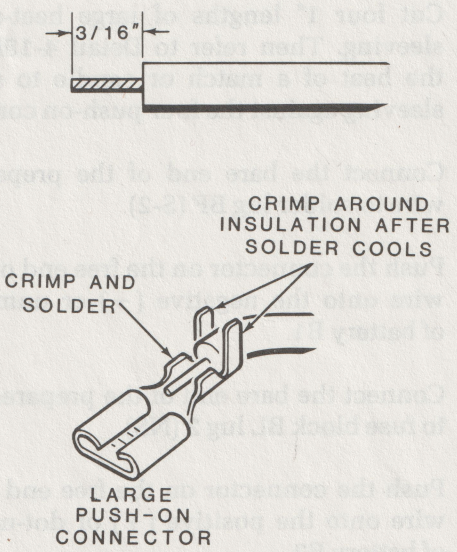
( ) Prepare the following wires:

5″ black (large)

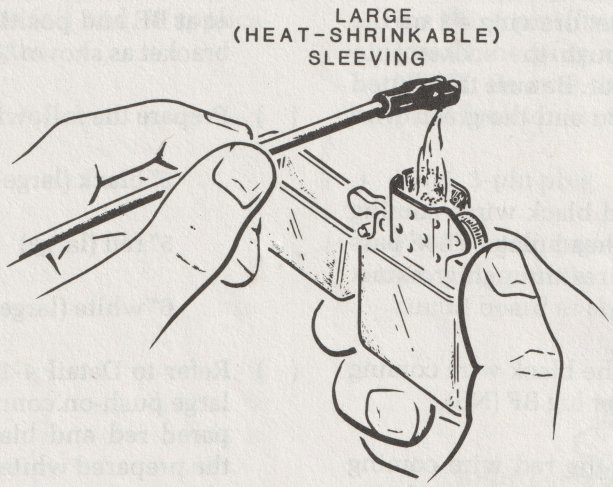
5″ red (large)

6″ white (large)

( ) Refer to Detail 4-15C and crimp and solder a large push-on connector on one end of the prepared red and black wires and both ends of the prepared white wire.



Detail 4-15C



Detail 4-15D

( ) Cut four 1″ lengths of large heat-shrinkable sleeving. Then refer to Detail 4-15D and use the heat of a match or candle to shrink the sleeving against the four push-on connectors.

( ) Connect the bare end of the prepared black wire to solder lug BF (S-2).

( ) Push the connector on the free end of the black wire onto the negative (−) or unmarked lug of battery B1.

( ) Connect the bare end of the prepared red wire to fuse block BL lug 2 (NS).

( ) Push the connector on the free end of the red wire onto the positive (+) or dot-marked lug of battery B2.

( ) Push the connector on one end of the prepared white wire onto the positive (+) or dot-marked lug of battery B1. Push the connector on the other end of the white wire onto the negative (−) or unmarked lug of battery B2.

( ) Prepare a 6″ large red wire.

( ) Connect one end of the prepared red wire to fuse block BL lug 2 (S-2).

( ) Pass the free end of the red wire up through grommet BB. Then connect it to the **eyelet** of lug 1 of terminal strip BL (S-1).

( ) Position a large cable clamp around all of the wires and cables coming from grommet HA of the head plate as shown in the Pictorial. Then use a #6 D-washer and a 6-32 × 3/8″ hex head screw to secure the clamp to the front sub-panel at FF.

( ) Refer to inset drawing #2 on the Pictorial and install three cables ties on the wires and cables coming from grommet HA in the areas shown.

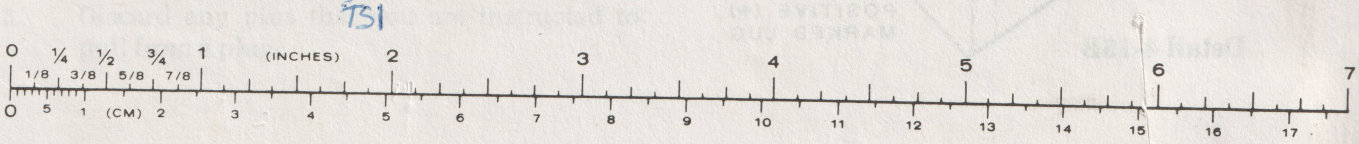
( ) Use the following procedure to mount a body side panel onto one side of the chassis:

1. Push a 7/16″ rubber grommet into each of the four larger holes in the body side panel.

2. Use four #6 × 3/8″ hex head sheet metal screws to mount the panel to the head and base plates.

( ) Similarly, install four 7/16″ rubber grommets in the remaining body side panel and mount it on the other side of the chassis.

( ) Set the chassis aside until it is called for in a step.



HEAD PANEL ASSEMBLY

Refer to Pictorial 4-16 (Illustration Booklet, Page 22) for the following steps.

( ) Position the head panel as shown in the Pictorial.

( ) Refer to Detail 4-16A and use the following procedure to install a 6-32 brass press-in nut at TA:

1. Start the small end of the nut into the stud at TA.

2. Clean the tip of your soldering iron. Then touch the hot tip to the top of the nut. NOTE: Do not let the hot soldering iron touch anything except the nut.

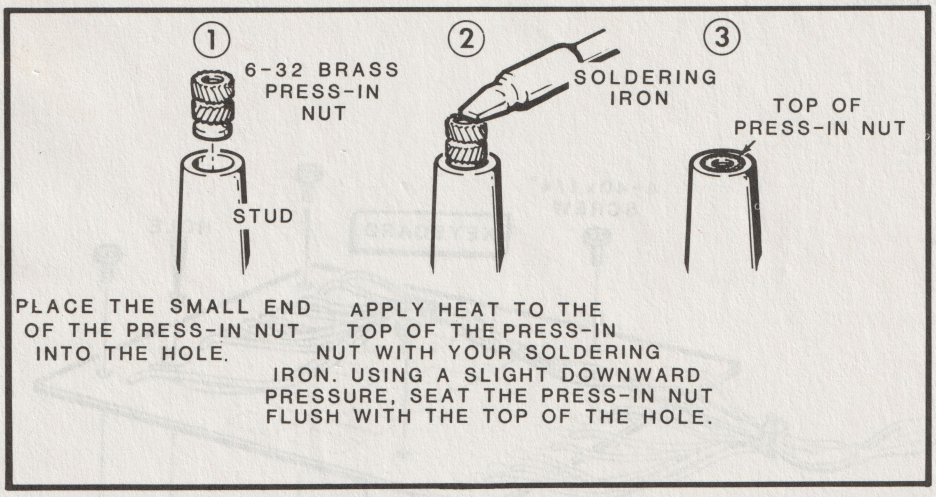
3. As the heated nut softens the plastic around the hole, press the nut straight into the hole so its top is just even with the top of the hole.

4. Remove the soldering iron tip and let the nut cool.

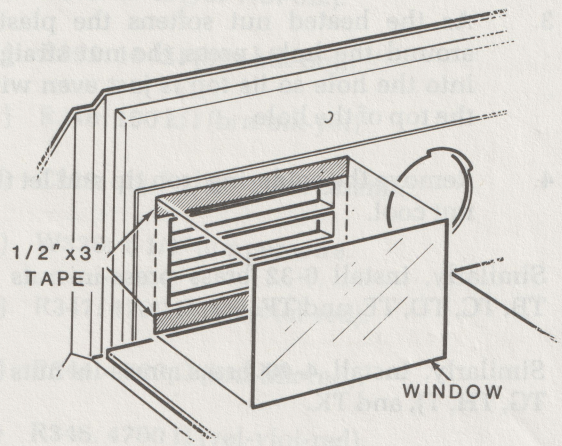
( ) Similarly, install 6-32 brass press-in nuts at TB, TC, TD, TE, and TF.

( ) Similarly, install **4-40** brass press-in nuts at TG, TH, TJ, and TK.

( ) Carefully peel the backing paper from two cable clips. Then press a clip onto the inside of the head panel at TL and TN. Be sure the open end of each clip faces away from you.


1
6-32 BRASS PRESS-IN NUT
STUD
2
SOLDERING IRON
3
TOP OF PRESS-IN NUT
PLACE THE SMALL END OF THE PRESS-IN NUT INTO THE HOLE.
APPLY HEAT TO THE TOP OF THE PRESS-IN NUT WITH YOUR SOLDERING IRON. USING A SLIGHT DOWNWARD PRESSURE, SEAT THE PRESS-IN NUT FLUSH WITH THE TOP OF THE HOLE.

Detail 4-16A



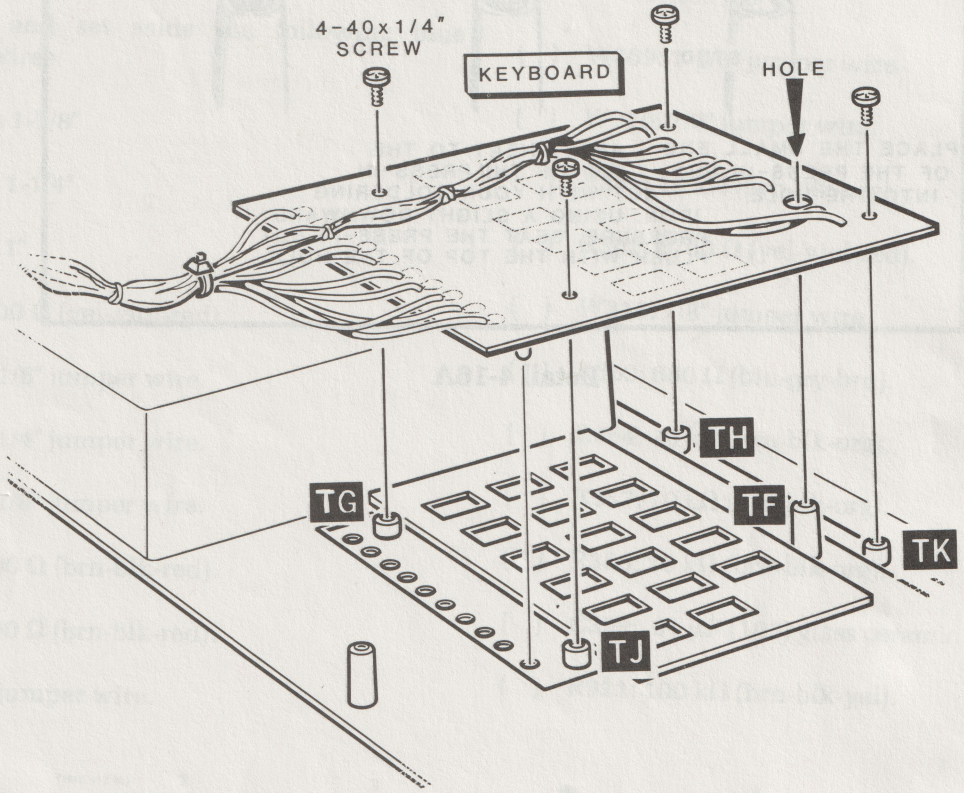
Detail 4-16B

( ) Cut two 1/2" × 3" lengths of double-stick tape. Use these lengths of tape in the next step.

( ) Refer to Detail 4-16B and use the following procedure to install the window on the inside of the head panel:

1. Carefully peel the backing paper from one side of each length of tape. Then press a length of tape above and below the slotted opening in the front of the head panel.

2. Peel the backing paper from the remaining side of each piece of tape. Then press the window onto the tape so it completely covers the slotted opening.



Detail 4-16C

( ) Refer to Detail 4-16C and use the following procedure to mount the keyboard into the head panel:

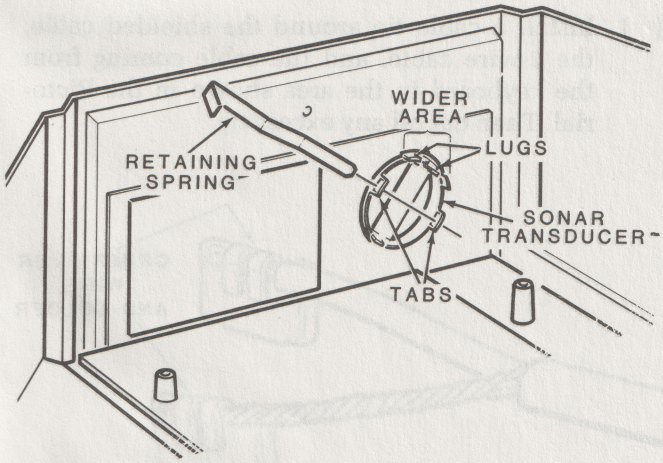
1. Make sure the LEDs on the keyboard are still perpendicular to the circuit board.

2. Position the keyboard into the head panel so the stud at TF passes through the larger hole in the keyboard circuit board. Also make sure the LEDs and the keys pass through their respective head panel holes.

3. Use four 4-40 × 1/4″ screws to secure the keyboard to the head panel at TG, TH, TJ, and TK.

4. Route the cable coming from the keyboard as shown and press it into the cable clip at TL. The connector on the free end of this cable will be connected later.

( ) A4: Refer to Detail 4-16D, and use the following procedure to install the sonar transducer (#473-35) in the head panel at A4:



Detail 4-16D

1. From the outside of the panel, start the transducer into hole A4 so the lugs pass through the wider area of the hole.

2. Hold the transducer in place while you pass the retaining spring through the tabs of the transducer to hold it in place.

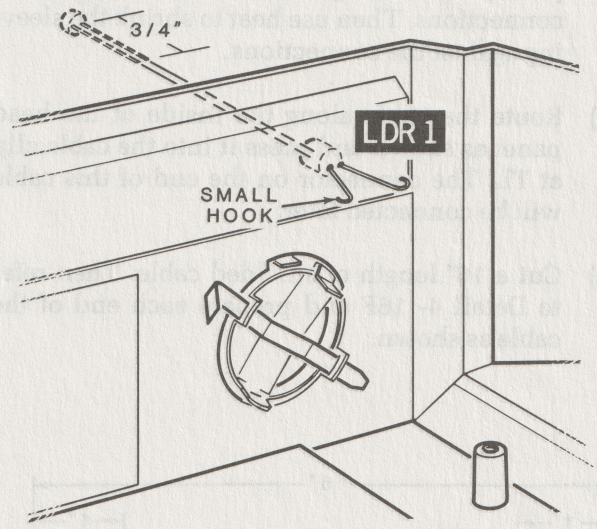
( ) LDR1: Refer to Detail 4-16E, and use the following procedure to install the photo resistor (#9-67) in the head panel at LDR1:

1. Cut the leads to a length of 3/4″. Then from outside the panel, insert the leads into the holes in the panel at LDR1.

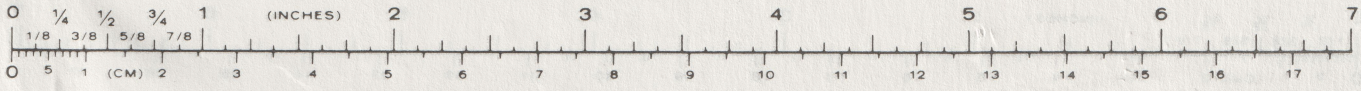
2. Bend the leads out slightly to hold the sensor in place.

3. Form a small hook in the ends of the leads coming from the sensor as shown.

( ) Use a pair of pliers and straighten the SONAR transducer retaining spring so it will fit into the SONAR transducer TABS in the Next step.



Detail 4-16E



( ) Cut a 15″ length of 2-wire cable. Separate the wires at each end of the cable for 1-1/4″. Then prepare the ends.

( ) Install a small spring connector onto each wire at one end of the 2-wire cable.

( ) Position a 3-pin socket shell as shown in the Pictorial. Then push the spring connector on one of the wires into hole 2 and the other wire into hole 3 of the socket shell.

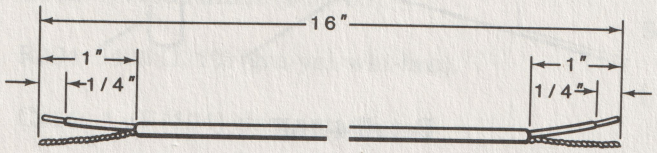
( ) Cut two 1″ lengths of small heat-shrinkable sleeving. Then slide a piece of sleeving onto each lead at the free end of the prepared 2-wire cable.

( ) Form a small hook in the ends of each wire at the end of the 2-wire cable where you have the small sleeving. Then hook the wires onto the leads of photo resistor LDR1 and solder the connections.

( ) Slide the sleeving down the wires so they completely cover the photo resistor leads and the connections. Then use heat to shrink the sleeving against the connections.

( ) Route the cable along the inside of the head panel as shown and press it into the cable clip at TL. The connector on the end of this cable will be connected later.

( ) Cut a 16″ length of shielded cable. Then refer to Detail 4- 16F and prepare each end of the cable as shown.



Detail 4-16F

( ) Install a small spring connector on each wire at one end of the prepared cable.

( ) Position a 3-pin socket shell as shown in the Pictorial. Then push the spring connectors on the prepared cable into the socket shell as follows:

Inner wire into hole 2

Shield wires into hole 3

( ) Refer to Detail 4-16G and install a small push-on connector on each wire at the free end of the prepared shielded cable.

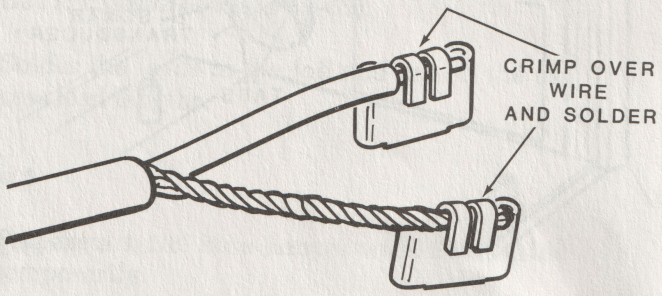
( ) Carefully push the push-on connectors onto sonar tranducer A4 as follows:

Inner wire onto lug 2

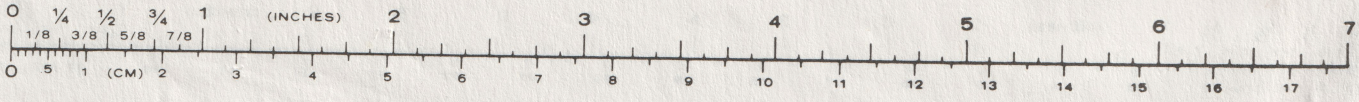
Shield wire onto lug 1

( ) Route the shielded cable along the inside of the head panel as shown in the Pictorial. Then press it into the cable clip at TL. The connector on the free end of this cable will be connected later.

( ) Install a cable tie around the shielded cable, the 2-wire cable, and the cable coming from the keyboard in the area shown in the Pictorial. Then cut off any excess tie.



Detail 4-16G



Refer to Pictorial 4-17 (Illustration Booklet, Page 23) for the following steps.

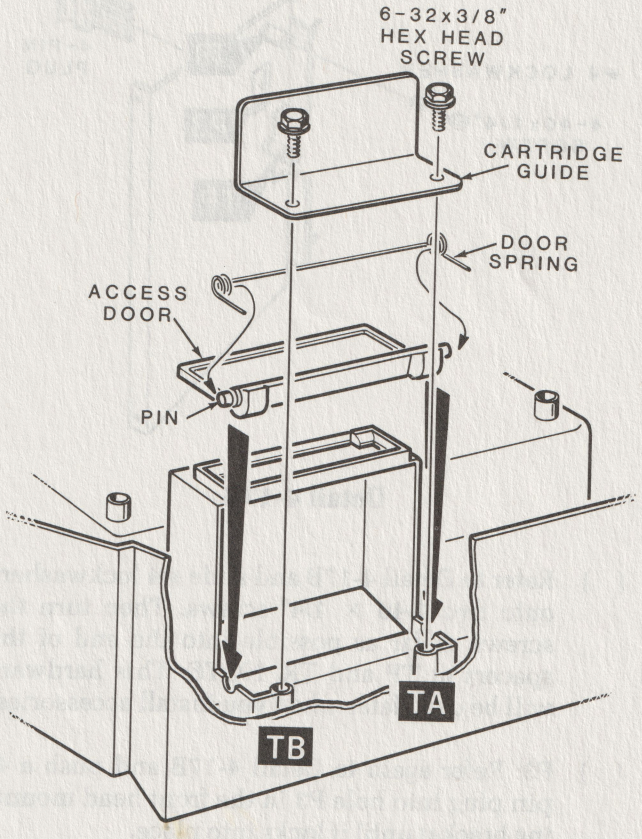
( ) Refer to Detail 4-17A and use the following procedure to install the access door in the head panel at the indicated location:

1. Position the access door and door spring as shown. Then place the spring over both door pins.

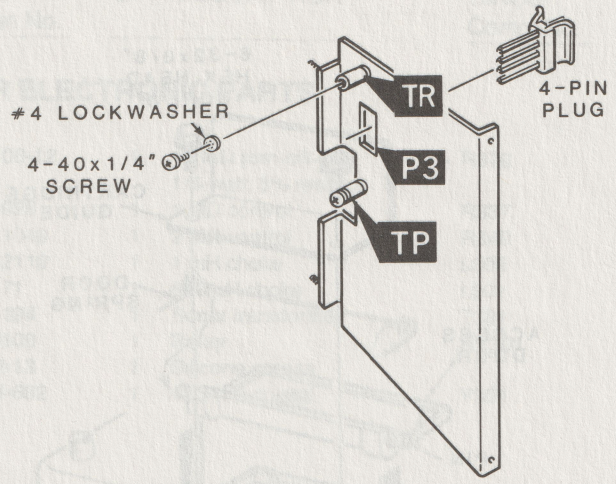
2. Place the access door/door spring assembly in the head panel so the door pins rest in the corresponding grooves in the panel.

3. Use two 6-32 × 3/8″ hex head screws to mount the cartridge guide at TA and TB. Be sure to position the guide as shown.

( ) Use 6-32 × 3/8″ hex head screws to mount the rear head mounting bracket onto the head panel at TC and TD. Be sure to position the bracket as shown in the Pictorial.



Detail 4-17A



Detail 4-17B

( ) Refer to Detail 4-17B and slide #4 lockwashers onto two 4-40 × 1/4" screws. Then turn the screws as far as possible into the end of the spacers at TP and TR. NOTE: This hardware will be used later when you install accessories.

( ) P3: Refer again to Detail 4-17B and push a 4-pin plug into hole P3 in the front head mounting bracket until it locks into place.

( ) Use two 6-32 × 3/8" hex head screws to mount the front head mounting bracket to the head panel at TE and TF. Be sure to position the bracket as shown in the Pictorial.

( ) Install the U-shaped gasket on the indicated edge of the front head mounting bracket.

( ) R1: Cut both leads of 1.8 MΩ (brn-gry-grn) resistor to 3/8". Then refer to the inset drawing on Pictorial 4-17 and connect the resistor from plug P3 lug 1 (NS) to plug P3 lug 2 (NS).

( ) Locate the green, blue, violet, and gray 4-wire cable that you set aside earlier. Separate and discard the gray wire from the other wires. Then cut the remaining 3-wire cable to a length of 16".

( ) Separate the wires at each end of the 3-wire cable for 1- 1/4" and prepare the ends.

( ) Install a small spring connector onto each wire at one end of the prepared cable.

Position a 4-pin socket shell as shown in the Pictorial. Then push the spring connectors on the prepared cable into the socket shell as follows:

( ) Green wire into hole 1.

( ) Blue wire into hole 2.

( ) Violet wire into hole 4.

( ) Position a polarizing pin with the "catch" upward as shown in the Pictorial. Then push the pin into hole 3 of the socket shell.

Connect the wires at the free end of the 3-wire cable to plug P3 as follows. NOTE: Connect these wires as close to the head mounting bracket as possible so you can cut off the excess lug lengths later.

( ) Violet wire to lug 1 (S-2).

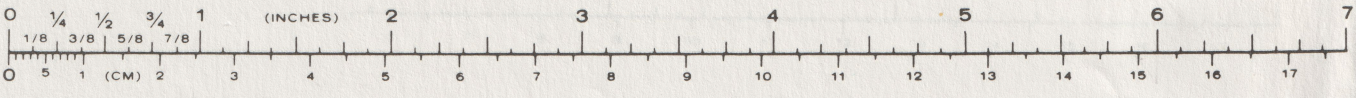
( ) Blue wire to lug 2 (S-2).

( ) Green wire to lug 4 (S-1).

( ) Carefully cut off any excess lengths from the pins of plug P3 (on the side where you connected the cable wires).

( ) Route the 3-wire cable down along the inside of the head panel as shown in the Pictorial. then press it into the cable clip at TN. The free end of this cable will be connected later (if you install the optional Infrared Motion Detector).

NOTE: If you have the optional Infared Motion Detector (RTA-1-1) accessory, complete the steps in its Instructions at this time. Then proceed with the following steps.



Refer to Pictorial 4-18 (Illustration Booklet, Page 23) for the following steps.

( ) Position the head assembly above the chassis assembly as shown in the Pictorial.

NOTE: Perform only one of the next two steps. If you installed the optional Infrared Motion Detector (RTA-1-1), perform the next step. If you did not install this option, however, skip the next step and follow the instructions in the second step.

( ) Locate the 4-pin socket on the free end of the 3-wire cable. Then push this socket onto power/sense circuit board plug P303. Be sure the violet wire is at plug pin 8.

( ) Fold the end of the 3-wire cable, coming from plug P3 and press it into the cable clip at TN. (NOTE: Pictorial 4-17 shows the location of this clip.)

( ) Locate the 3-pin socket on the free end of the 2-wire cable. Then push this socket onto power/sense circuit board plug P306. Be sure the two wires are at plug pins 2 and 3.

( ) Locate the 25-pin socket on the free end of the cable coming from the keyboard. Then push this socket onto CPU circuit board plug P205. Be sure the white-red wire is at plug pin 25.

( ) Locate the 3-pin socket on the free end of the shielded cable. Then push this socket onto power/sense circuit board plug P305. Be sure the wires in this socket are at plug pins 2 and 3.

( ) Refer to Pictorial 4-18 and carefully lower the head assembly onto the chassis so the two screws in each head mounting bracket pass through the corresponding holes in the head plate. Be careful not to pinch any wires between the mounting brackets and the head plate. NOTE: The head assembly will be secured into place later.

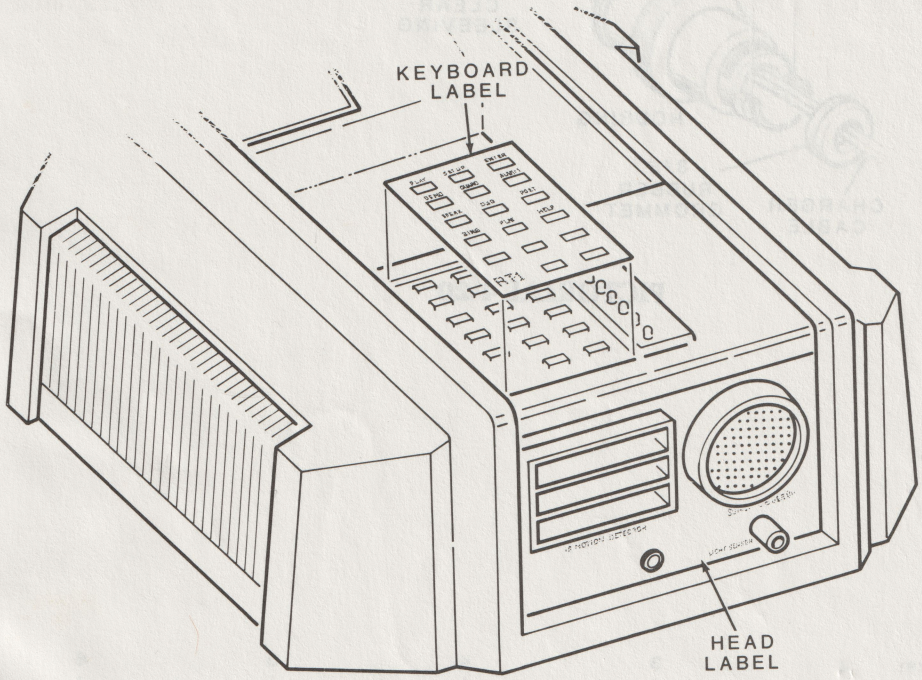
Refer to Pictorial 4-19 for the following steps.

( ) Reposition the chassis assembly as shown in the Pictorial.

( ) Carefully peel the backing paper from the keyboard label. Then match up the holes in the label with the keyboard keys and press the label into place on the head panel.

( ) Carefully peel the backing paper from the head label. Then press the label onto the front of the head panel as shown. Save the 2″ diameter large round portion of the label for use later.

( ) Set the chassis assembly aside until it is called for in a step.



PICTORIAL 4-19

Refer to Pictorial 4-20 for the following steps.

( ) Locate the battery charger. Then cut off the plug on the free end of the cable.

( ) Separate the wires at the free end of the charger cable for 1″ and prepare the ends.

( ) Remove the three screws and the clamp from the 4-pin power plug. Then twist the connector housing and base in opposite directions and remove the housing.

( ) Slide the 3/8″ rubber grommet (#73-59) over the free end of the charger cable.

( ) Pass the free end of the charger cable through the connector housing and the clear sleeving.

Connect the wires at the end of the cable to the lugs of the connector base as follows:

( ) Marked wire to lug 2 (S-1).

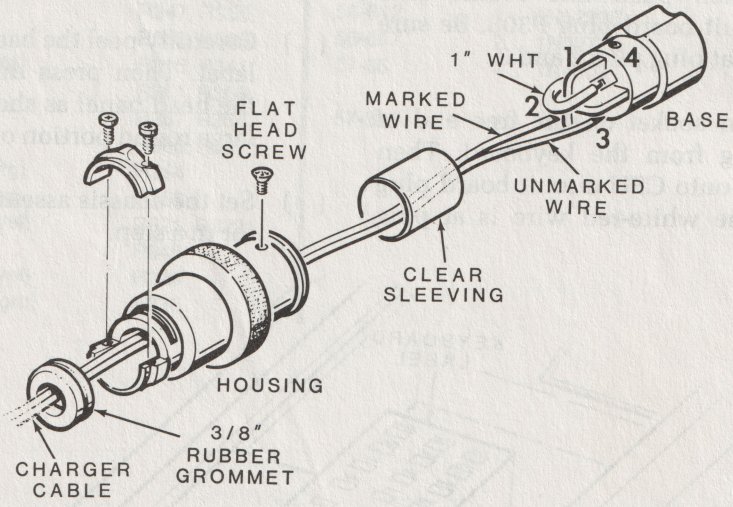
( ) Unmarked wire to lug 3 (S-1).

( ) Prepare a 1″ white wire.

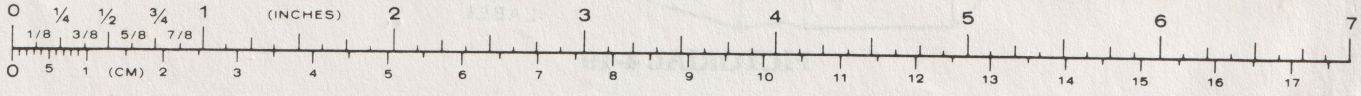
( ) Connect the prepared white wire from connector base lug 1 (S-1) to lug 4 (S-1).

( ) Reassemble the 4-pin power plug. Be sure you place the grommet under the clamp before you tighten the two screws that secure it to the housing.

This completes most of the assembly of your Robot. The body sections will be mounted later. Proceed to "Initial Tests."



PICTORIAL 4-20



INITIAL TESTS

In this section of the Manual, you will perform certain tests to verify that your Robot operates properly. If you do not obtain the correct result in any of the following tests, refer to the "In Case of Difficulty" section on Page 11 of the Technical Manual and correct the problem before you continue.

CAUTION: Do NOT apply power to Hero Jr until you are instructed to do so.

TEST PREPARATION

Refer to Pictorial 5-1 (Illustration Booklet, Page 24) for the locations of the controls and switches called out in the following steps.

( ) Set the following controls on the power/sense circuit board to the 12 o'clock (center) position:

R349 (LIGHT LEVEL)

R337 (SOUND LEVEL)

( ) Set the following controls on the CPU circuit board as noted:

R234 (VOLUME) — 12 o'clock position

R224 (PITCH) — 2 o'clock position

( ) Be sure the POWER OFF-ON switch is in the OFF position. If not, use a small-blade screwdriver or similar object to place the switch in the OFF position.

( ) Be sure the SLEEP-NORM switch is in the SLEEP position.

( ) Be sure you have not installed any fuse in fuse block F1 (mounted on the bottom front of the base plate).

( ) Be sure the battery charger is not connected between CHARGER socket J1 of the Robot and a 120-volt AC outlet.

POWER OFF TESTS

Hero Jr is a rather complex electronic device. Therefore, it is very important that you make each of the following resistance checks as completely and carefully as possible. These tests require that you know how to use an ohmmeter (DMM, VOM, or VTVM). If you do not have such a test instrument, borrow or obtain one; then become familiar with it for these tests. NOTE: If you cannot obtain an ohmmeter, proceed to "Wiring Checks" and complete the steps listed under that heading. Then proceed to "Power On Tests."

( ) Turn on your ohmmeter and allow it to warm up, if necessary.

( ) Set your ohmmeter to the R × 10 k range and connect its common lead to the Robot chassis.

Refer to Pictorial 5-1 (Illustration Booklet, Page 24) for the "test points" called out in the following steps.

( ) Touch the probe of your ohmmeter to fuse block F1 lug 1. The meter should indicate at least 100 kΩ.

( ) Place the POWER OFF-ON switch in the ON position.

( ) Set your ohmmeter to the R × 10 range.

( ) Again touch the probe of your ohmmeter to fuse block BL lug 1. The meter should indicate at least 100 Ω.

This completes the "Power Off Tests." Proceed to "Power On Tests."

WIRING CHECKS

( ) Carefully check the wiring of POWER OFF-ON switch SW1, SLEEP-NORM switch SW2, and CHARGER socket J1 against the wiring shown in Pictorial 4-14 (Illustration Booklet, Page 20).

( ) Make sure there are no fine strands of wire or glob of solder touching adjacent terminals or the connector bracket.

( ) Carefully check the wiring of power plug P1 (on the charger cable) against the wiring shown in Pictorial 4-20 on Page 72 of this Manual.

POWER ON TESTS

A DC voltmeter is required for the following tests. NOTE: If you do not have a voltmeter, ignore the steps directing you to make voltage measurements. However, be sure you complete the remaining steps in this section.

( ) Place the POWER OFF-ON switch in the OFF position.

( ) F1: Install a 4-ampere, 3AG, slow-blow fuse in the clips on fuse block BL.

( ) Set your voltmeter to measure positive DC voltages in the 15- to 20-volts range.

( ) Touch the probe of your voltmeter to fuse block F1 lug 1. The meter should read between +10.0 and +13.5 volts DC.

( ) Connect plug P1 at the end of the battery charger cable into CHARGER socket J1 on the Robot. Then plug the charger into a 120 VAC outlet.

( ) Again touch the probe of the voltmeter to fuse block F1 lug 1. The meter should read the same voltage as before. However, the voltage reading should increase slowly as the batteries are being charged.

( ) Charge the batteries to approximately 13.9 volts. NOTE: If you initially measured a low battery voltage (+10 volts), it will take about 12 hours to completely charge them. NOTE: You will not damage (overcharge) the batteries, even if you leave the charger plugged in for much more than 12 hours.

( ) After the batteries are fully charged, disconnect the battery charger from the AC outlet and Robot.

CAUTION: Never leave the battery charger connected to the Robot while it is unplugged from the AC outlet. If you do, your batteries will discharge. The life expectancy of the batteries may be drastically shortened if they are completely discharged.

( ) Place the POWER OFF-ON switch in the ON position. Then touch the probe of your voltmeter to fuse block F1 lug 1. The meter should read about +13.9 volts.

( ) Place the SLEEP-NORM switch in the NORM position. Then again touch the probe of your voltmeter to fuse block F1 lug 1. The meter should still read about +13.9 volts.

OPERATIONAL TESTS

( ) Place HERO Jr on the floor, if this has not already been done.

NOTE: As HERO Jr proceeds through the following checkout procedure, be sure you perform the instructions he gives you. Each phrase spoken by the Robot is shown in quotation marks and, if applicable, followed by the appropriate instruction.

( ) Push the keyboard RESET button. The power-on indicator (green LED) should light. HERO Jr should speak and proceed through the following checkout procedure, while the eight red LEDs flash on and off.

( ) 1. "Checking memory."

( ) 2. "Checking sonar." "Please wave your hand in front of my sonar." – Move your hand in front of the Robot, at least 4 inches away from the sonar transducer.

( ) 3. "Sonar ok."

( ) 4. "Checking steering."

( ) 5. "Steering ok."

( ) 6. "Checking light sensor. Please wave your hand in front of my light sensor." – Place one of your fingers directly over the light sensor.

( ) 7. "Light sensor ok."

( ) 8. "Checking drive motor." NOTE: Make sure the Robot is on the floor, as it may start to move.

( ) 9. "Drive motor ok."

( ) 10. "Checking sound sensor." NOTE: HERO Jr now listens to himself talk.

( ) 11. "Sound sensor ok."

( ) 12. "Checking motion detector. Please wave your hand in front of my motion detector." – Wave your hand in front of the Robot. NOTE: The purpose of this step is to check the optional Infrared Motion Detector. If this accessory has not been installed, the Robot will respond with: "Motion detector malfunction."

( ) 13. "Motion detector ok."

( ) 14. "Daylight savings time selected. Press ENTER to confirm. Press C to change." NOTE: If you live in an area that **observes** daylight savings time, press ENTER; otherwise press C to change. Then press ENTER when asked to confirm "**No** daylight savings time selected. . ."

( ) 15. "Enter day." – Enter 1 for Sunday, 2 for Monday, etc.

( ) 16. "Enter time and date. Hours." – Enter two digits (06, for example).

( ) 17. "Minutes." – Enter two digits (45, for example).

( ) 18. "Press A for AM; press E for PM."

( ) 19. "Month." – Enter two digits (08 for August, for example).

( ) 20. "Date." – Enter two digits (05 for the 5th, for example).

( ) 21. "Year." – Enter two digits (84 for 1984, for example).

( ) 22. HERO Jr should tell you the date and time.

( ) 23. "Press ENTER to confirm or C to change." NOTE: The Robot's clock will start as soon as you press ENTER.

( ) 24A. "Enter special date. Enter date, month." – Enter two digits (06 for June, for example). NOTE: Enter the date of your wedding anniversary, birthday, or any other special day.

"Day" – Enter two digits (18 for the 18th, for example).

"Year" – Enter two digits for the year (84 for 1984, for example), if you wish to be reminded of the special day for only one specific year. However, if you wish to be reminded of that special day every year, press ENTER.

"Press ENTER to confirm or C to change."

( ) 24B. If you press ENTER, HERO Jr should say: I am HERO Jr, your personal robot. I am your friend, companion, and security guard. Ready." – The Robot is now ready for operation.

This completes the "Initial Tests." Proceed to "Adjustments."

ADJUSTMENTS

The adjustments you made during "Initial Tests" were performed to assure nominal operation of your Robot. However, the following adjustment procedure will allow you to achieve optimum performance of the sound and light sensing, voice volume and pitch, and time-keeping of the clock.

You may want to perform only those adjustments for a function that appears to need it, or you may want to go through all of the adjustments to further familiarize yourself with the operation and capabilities of HERO Jr.

SENSE

Depending on the sound and light levels that HERO Jr is exposed to, you may wish to change the setting of the controls that affect the sensitivity of these sensing devices. Pictorial 5-1 (Illustration Booklet, Page 24) shows the location of the controls used in the following adjustments.

NOTES:

1. Clockwise rotation of each of the following controls increases the sensitivity of the applicable circuit, while counterclockwise rotation decreases the sensitivity.

2. Each time you change the setting of any of the following controls, be sure you then complete the steps of the "Operational Tests" on Page 75 of this Manual.

A. Be sure the SLEEP-NORM switch is in the NORM position. Then press the RESET key. Within a few seconds, you should hear "ready" from the Robot's speaker.

SOUND

1. While you hold down the Robot's ENTER key, press and release the 0 key. The Robot will say: "Robot Wizard."

2. Enter F95D on the Robot's keyboard and press ENTER. Then adjust SOUND LEVEL control R337. As you adjust the control, make a constant monotone sound. The LEDs on top of the Robot will flash, counting in hexadecimal (which is a number system with a base of 16). As more LEDs light, the Robot's sound sensor will become more sensitive and respond to quieter and quieter sounds. Do not set the control so that all the LEDs are on; set it so only about half of them are on (or just ordinary room noises will make it respond).

3. Press the RESET key.

LIGHT

1. While you hold down the Robot's ENTER key, press and release the 0 key. The Robot will say: "Robot Wizard."

2. Enter F952 on the Robot's keyboard and press ENTER. Then adjust LIGHT LEVEL control R349. As you adjust the control, place a finger against the light sensor to block out most of the light. The LEDs on top of the Robot will flash (counting in hexadecimal). As more LEDs light, the Robot's light sensor will become more sensitive and respond to dimmer and dimmer light.

3. When you have the control set to a position that you want to try, press RESET.

SPEECH

You can adjust HERO Jr's pitch from baritone to soprano, and the volume from a whisper to a shout. Pictorial 5-1 (Illustration Booklet, Page 24) shows the location of the adjustment controls for the speech.

1. With the POWER OFF-ON switch in the ON position, press the RESET key. Within a few seconds, you should hear "ready" from HERO Jr's speaker.

2. As HERO Jr proceeds through the checkout procedure, adjust PITCH control R224 for the pitch you prefer and VOLUME control R234 for your desired listening level. NOTE: The proper setting of each of these controls is determined by your personal preference; however, others may have less difficulty understanding the Robot if the speech is a slow, rich baritone.

TIME

NOTE: Perform the steps in this section of your Manual only if your Robot does not keep time satisfactorily.

If you have a frequency counter, you can accurately set the timer with a single adjustment. Otherwise, you can set the time with a known standard and compare every day, adjusting for fast or slow time as needed.

A. Make sure the POWER OFF-ON switch is in the OFF position.

B. Refer to Pictorial 4-18 (Illustration Booklet, Page 23) and disconnect socket S205 from the CPU circuit board; disconnect sockets S303, S305, and S306 from the power/sense circuit board. Then set the head aside temporarily.

C. Remove and set aside the four 4-40 × 1/4″ screws that secure the power/sense circuit board to the four spacers below it. Then refer to Pictorial 5-2 (Illustration Booklet, Page 25) and position the power/sense circuit board as shown.

FREQUENCY COUNTER METHOD

1. Place the POWER OFF-ON switch in the ON position.

2. Make sure the SLEEP-NORM switch is in the NORM position.

3. Again refer to Pictorial 5-2 and connect your frequency counter to pin 2 of integrated circuit U213 on the CPU circuit board.

4. Adjust OSC TRIM capacitor C228 for a reading of 32.768 kHz ± .001 kHz on the counter.

5. Disconnect the counter from the CPU circuit board.

6. Reinstall the power/sense circuit board on the four spacers. Then position the head assembly above the chassis assembly, and reconnect the four sockets that you previously disconnected from the circuit boards.

TIME STANDARD METHOD

1. Place the POWER OFF-ON switch in the ON position.

2. Make sure the SLEEP-NORM switch is in the NORM position.

3. Preset OSC TRIM capacitor C228 with its slot horizontally as shown in Pictorial 5-2. NOTE: Be sure the metal drop on the capacitor is positioned as shown in the inset drawing.

4. Enter RESET on the keyboard. After a short pause, HERO Jr should say "ready."

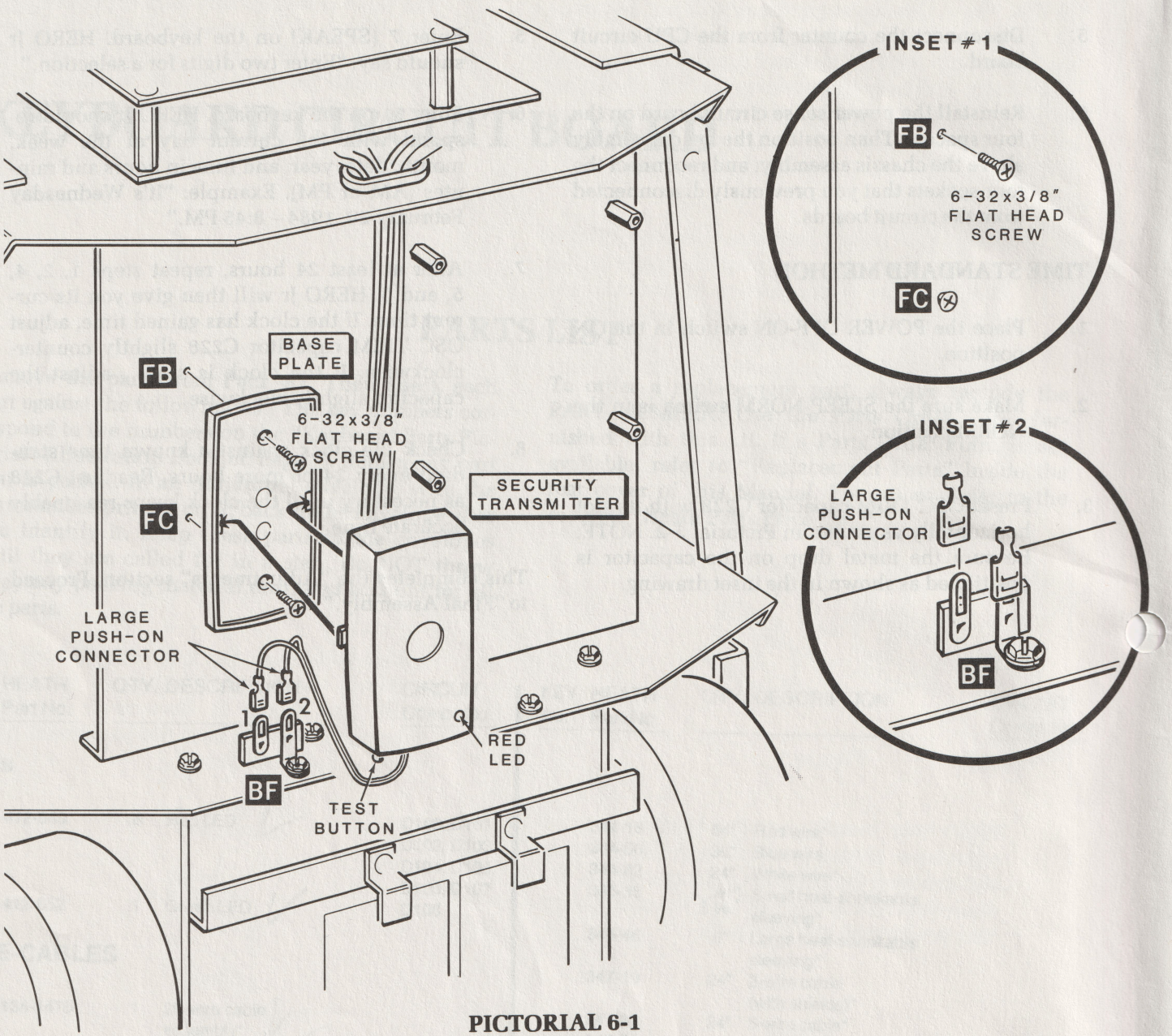
5. Enter 7 (SPEAK) on the keyboard. HERO Jr should say: "Enter two digits for a selection."

6. Enter 01 on the keyboard. HERO Jr should respond with the current day of the week, month, date, year, and time in hours and minutes (AM or PM). Example: "It's Wednesday February 29, 1984 – 8:45 PM."

7. After at least 24 hours, repeat steps 1, 2, 4, 5, and 6. HERO Jr will then give you its current time. If the clock has gained time, adjust OSC TRIM capacitor C228 slightly counterclockwise. If the clock is slow , adjust the capacitor slightly clockwise.

8. Check the clock against a known time standard every 24 or more hours. Readjust C228 as necessary until the clock keeps reasonably accurate time.

This completes the "Adjustments" section. Proceed to "Final Assembly."



PICTORIAL 6-1

SECURITY TRANSMITTER INSTALLATION

OPTION A

NOTE: Complete the following steps only if you have the optional Model GDA-2800-3 RF Security Transmitter accessory, and you intend to install it at this time. Otherwise, proceed to "Option B."

Refer to Pictorial 6-1 for the following steps.

( ) Remove the base plate from the Security Transmitter. Then use 6-32 × 3/8″ flat head screws to mount the base plate to the front subpanel at FB and FC. NOTE: You may mount the base plate either way.

( ) Install the Security Transmitter assembly onto the base plate as shown.

NOTE: Complete the next step only if the Security Transmitter's 2-wire cable did not have push-on connectors installed.

( ) Refer to Detail 6-1A and crimp and solder a large push-on conector on each wire of the 2-wire cable.

( ) Push the connector at the end of either wire of the 2-wire cable onto terminal strip BF lug 1.

( ) Push the connector at the end of the other wire of the 2-wire cable onto terminal strip BF lug 2.

( ) Wait about 30 seconds; then push the "test button" on the Security Transmitter. Its red LED indicator should light. If it does not, reverse the connections to terminal strip BF. Then wait another 30 seconds, push the "test button" again, and check to see that the LED indicator lights.

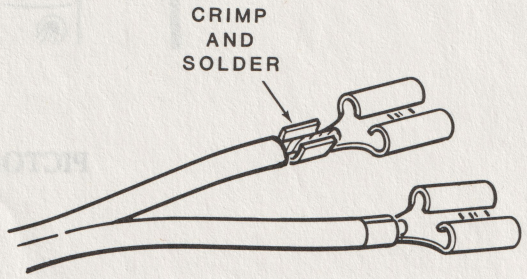
OPTION B

NOTE: Complete the following steps only if you do not intend to install the optional Model GDA-2800-3 RF Security Transmitter accessory at this time.

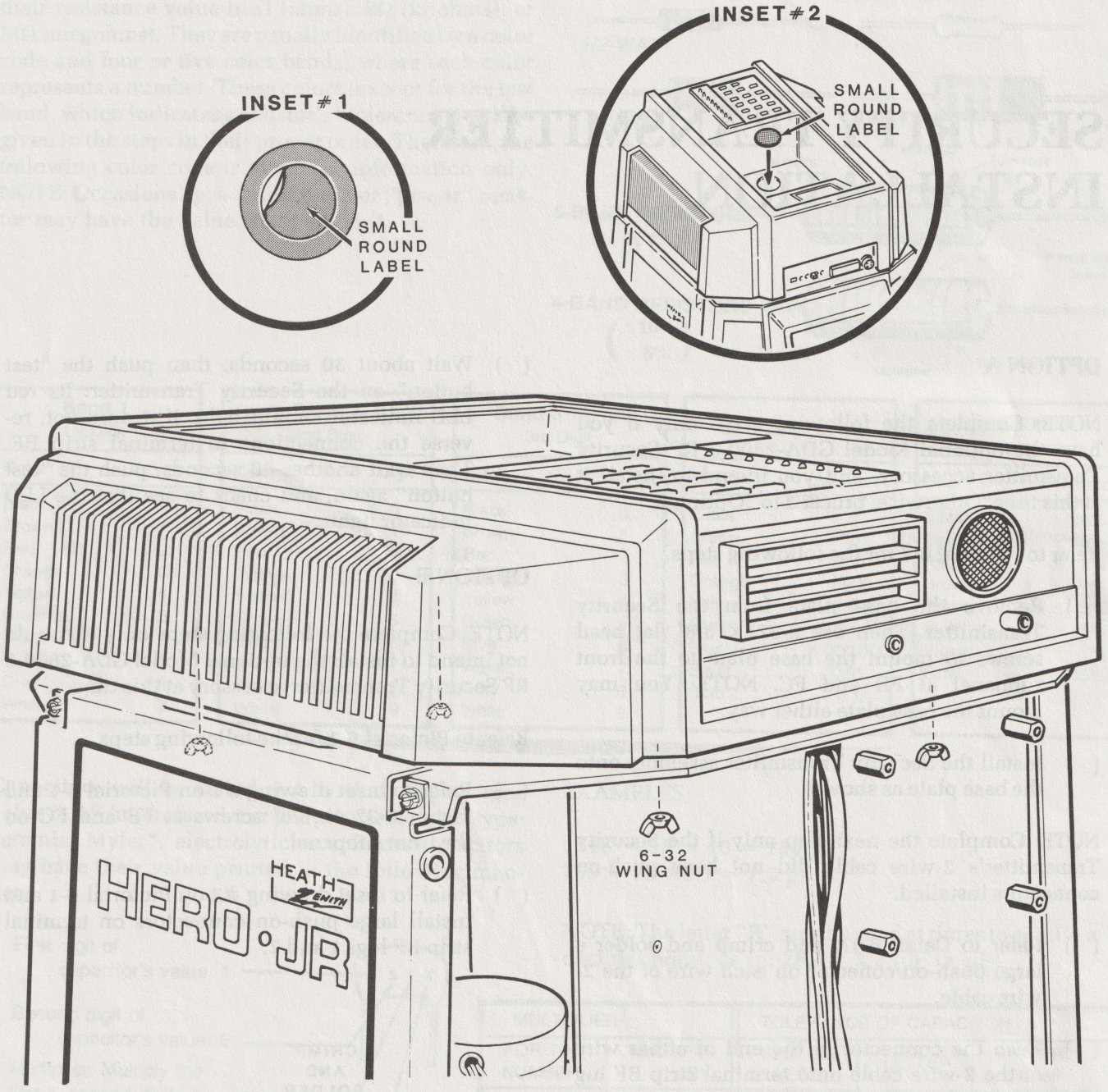
Refer to Pictorial 6-1 for the following steps.

( ) Refer to inset drawing #1 on Pictorial 6-1 and install 6-32 × 3/8″ screws at FB and FC on the front subpanel.

( ) Refer to inset drawing #2 on Pictorial 6-1 and install large push-on connectors on terminal strip BF lugs 1 and 2.



Detail 6-1A



PICTORIAL 7-1

FINAL ASSEMBLY

NOTE: If you have the optional Battery Accessory, (RTA-1-4), complete the steps in its Instructions at this time. Then proceed with the following steps.

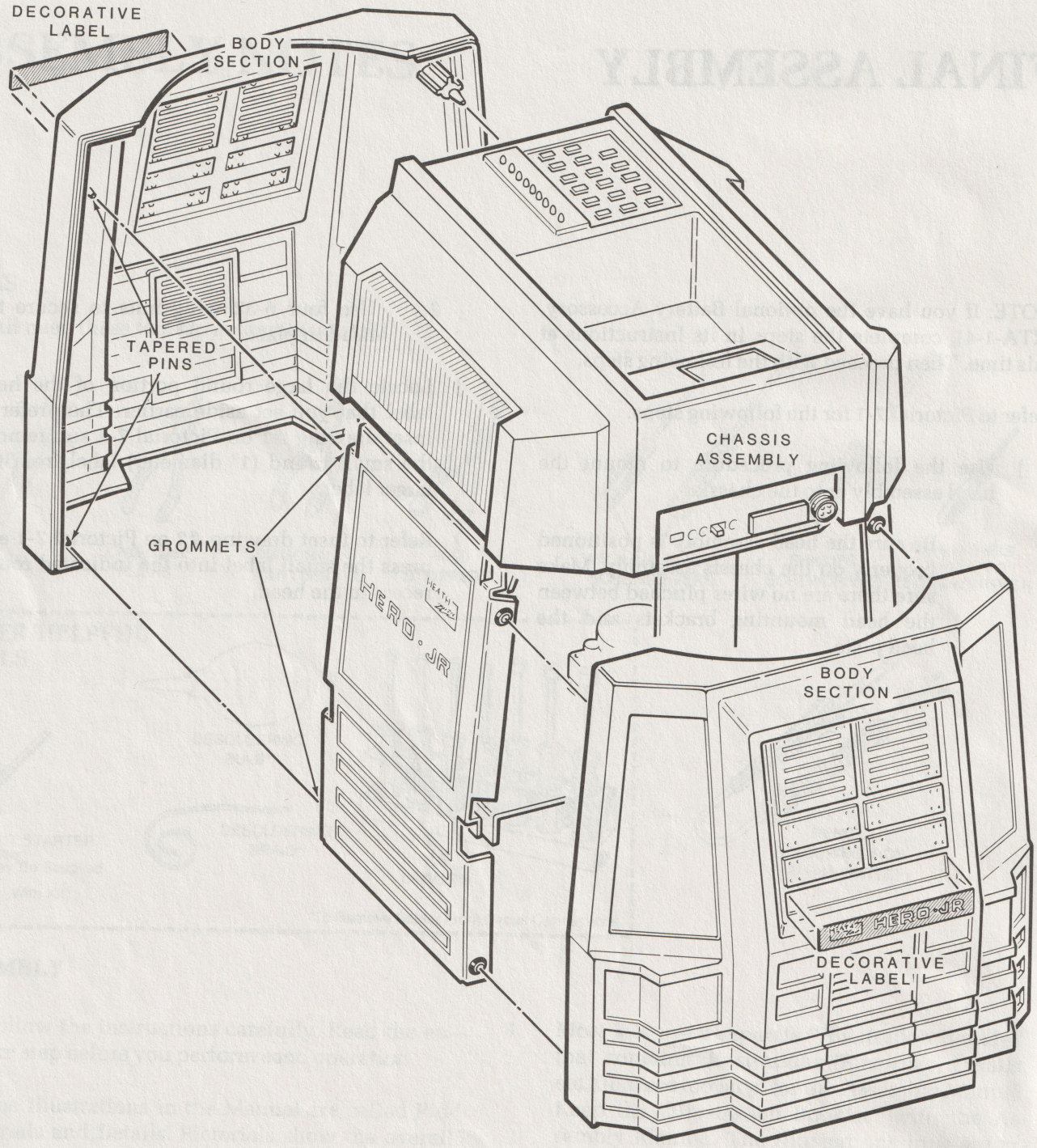
Refer to Pictorial 7-1 for the following steps.

( ) Use the following procedure to mount the head assembly onto the chassis:

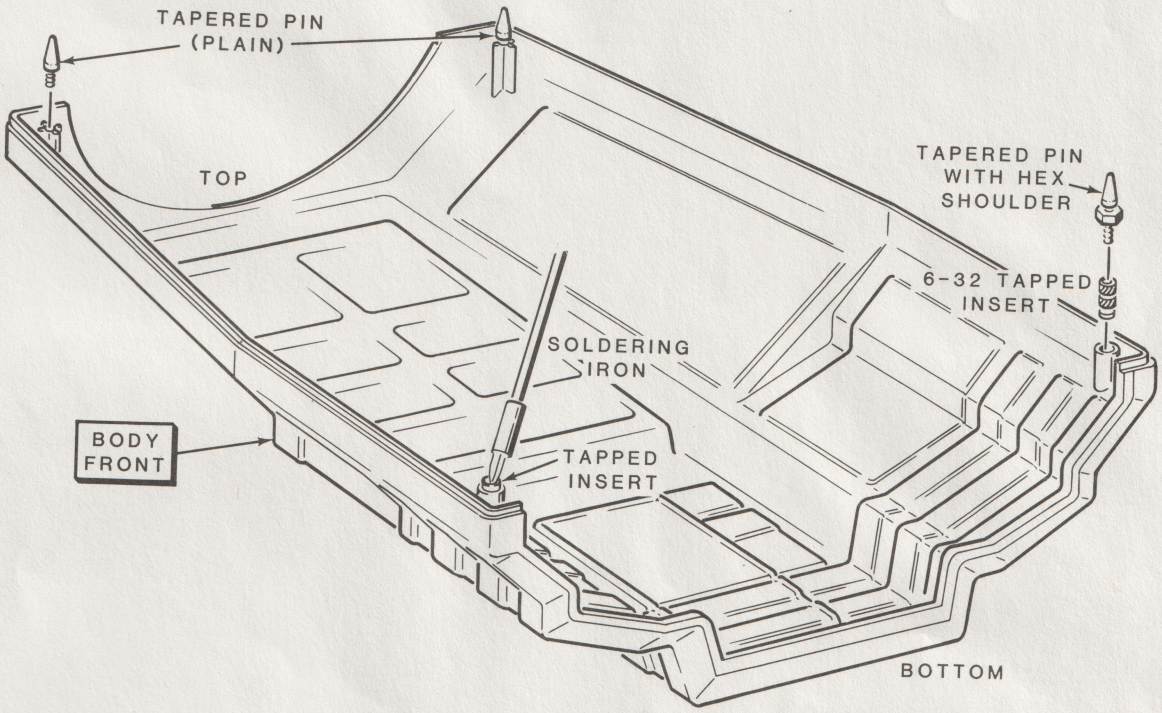
1. Be sure the head assembly is positioned properly on the chassis assembly. Make sure there are no wires pinched between the head mounting brackets and the head plate.
2. Use four 6-32 wing nuts to secure the head in place.

( ) Locate the large round portion of the head label that you set aside earlier. Then refer to inset drawing #1 on Pictorial 7-1 and remove the small round (1" diameter) label from the larger label.

( ) Refer to inset drawing #2 on Pictorial 7-1 and press the small label into the indicated round recess in the head.



PICTORIAL 7-2



Detail 7-2A

Refer to Pictorial 7-2 for the following steps.

( ) Loosen the hardware securing the connector bracket to the head plate. Then pull the bracket against the head and retighten the hardware.

( ) Position one of the body sections as shown in Detail 7-2A. Then use the hot tip of your soldering iron to install 6-32 brass press-in nuts in the indicated holes of the body section. Use the same method as you did when you installed the press-in nuts in the head panel.

( ) Refer again to Detail 7-2A and turn two tapered pins (with hex shoulder) into the two press-in nuts at the bottom of the body section.

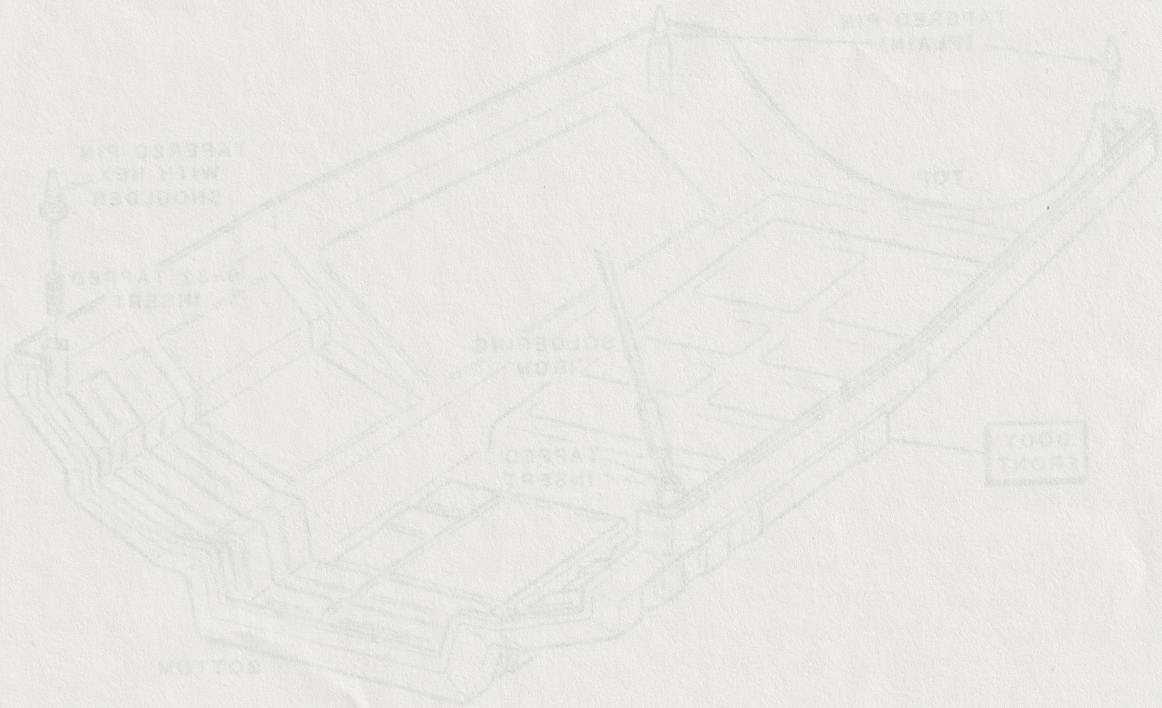
( ) Similarly, install two tapered pins (plain) into the press-in nuts at the top of the body section.

( ) Use the same procedure to prepare the other body section.

( ) Mount the two body sections to the chassis assembly. Press the four tapered pins on each body section firmly into the rubber grommets in the body side panels.

( ) Carefully peel the backing paper from the two decorative labels. Then press one of the labels into the indicated recess in each body section.

This completes the "Final Assembly." Proceed to the Owner's Guide.



CUSTOMER SERVICE

REPLACEMENT PARTS

Please provide complete information when you request replacements from either the factory or Heath Electronic Centers. Be certain to include the **HEATH** part number exactly as it appears in the parts list.

ORDERING FROM THE FACTORY

Print all of the information requested on the parts order form furnished with this product and mail it to Heath. For telephone orders (parts only) dial 616 982-3571. If you are unable to locate an order form, write us a letter or card including:

- Heath part number.
- Model number.
- Date of purchase.
- Location purchased or invoice number.
- Nature of the defect.
- Your payment or authorization for COD shipment of parts not covered by warranty.

Mail letters to: Heath Company
Benton Harbor
MI 49022
Attn: Parts Replacement

Retain original parts until you receive replacements. Parts that should be returned to the factory will be listed on your packing slip.

OBTAINING REPLACEMENTS FROM HEATH ELECTRONIC CENTERS

For your convenience, "over the counter" replacement parts are available from the Heath Electronic Centers listed in your catalog. Be sure to bring in the original part and purchase invoice when you request a warranty replacement from a Heath Electronic Center.

TECHNICAL CONSULTATION

Need help with your kit? — Self-Service? — Construction? — Operation? — Call or write for assistance. you'll find our Technical Consultants eager to help with just about any technical problem except "customizing" for unique applications.

The effectiveness of our consultation service depends on the information you furnish. Be sure to tell us:

- The Model number and Series number from the blue and white label.
- The date of purchase.
- An exact description of the difficulty.
- Everything you have done in attempting to correct the problem.

Also include switch positions, connections to other units, operating procedures, voltage readings, and any other information you think might be helpful.

Please do not send parts for testing, unless this is specifically requested by our Consultants.

Hints: Telephone traffic is lightest at midweek — please be sure your Manual and notes are on hand when you call.

Heathkit Electronic Center facilities are also available for telephone or "walk-in" personal assistance.

REPAIR SERVICE

Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

If it is convenient, personally deliver your kit to a Heathkit Electronic Center. For warranty parts replacement, supply a copy of the invoice or sales slip.

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address.
- Date of purchase and invoice number.
- Copies of all correspondence relevant to the service of the kit.
- A brief description of the difficulty.
- Authorization to return your kit COD for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. (Do not include any wooden cabinets or color television picture tubes, as these are easily damaged in shipment. Do not include the kit Manual.) Place the equipment in a strong carton with at least THREE INCHES of *resilient* packing material (shredded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weighs over 15 lbs., place this carton in another one with 3/4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or insured Parcel Post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022

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